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ABSTRACT

This document is intended to inform and advise the development and operation of campuswide information technology (IT) education and training programs at two-year colleges belonging to the EnterpriseOhio Network (EON). The report is based on information from the following sources: a comprehensive national literature review; an environmental scan of Ohio; a review of state and national IT worker supply and demand data; and focus group discussions with employers throughout rural and urban areas of Ohio. The following are among the topics examined in the report's six chapters: (1) research approaches and applications and a rationale for change; (2) the demand for IT workers in Ohio and nationwide; (3) IT skill requirements (soft, business, and technical skill requirements; the importance of work-based learning and vendor/industry certification; preferred methods of IT skill acquisition; incumbent worker training; model curricula and skill standards); (4) trend analysis on the supply of IT workers in Ohio and nationwide; (5) service delivery opportunities for the EON based on employer

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demand; and (6) the ECN as a primary resource for Ohio (producing IT workers, raising technological competencies, integrating IT learning across academic disciplines, investing in IT faculty, providing technology access for Ohioans). Sixty-two tables/figures are included. (MN)

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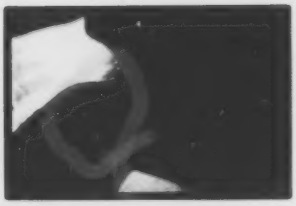
EnterpriseOhio NETWORK

Two Year Campuses in Partnership – Making Learning for the Workplace Count

Information Technology Skills



Ohio Employers' Labor Demand

Implications for EnterpriseOhio Network Campus-wide Leadership

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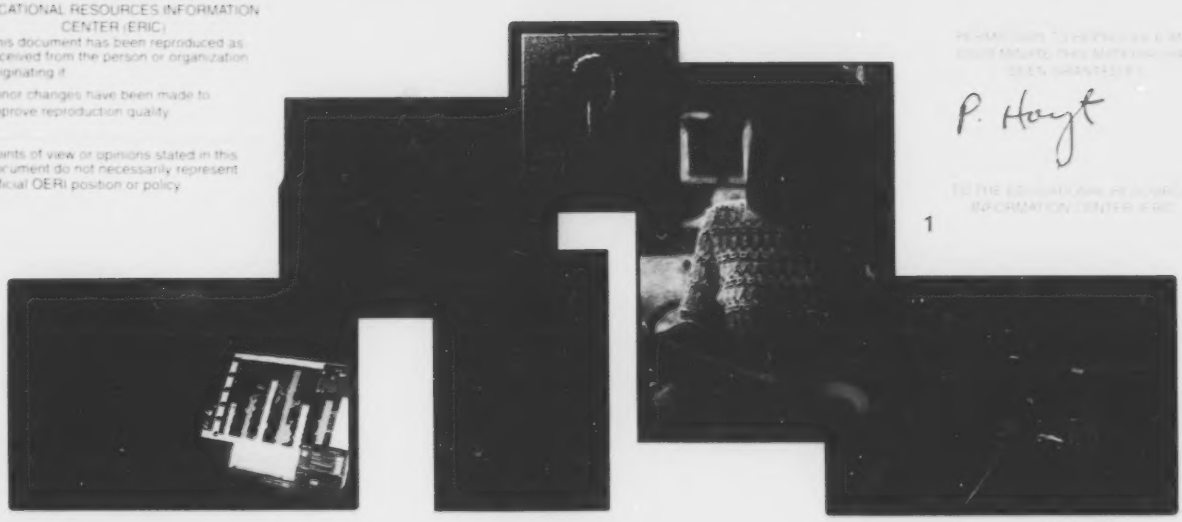

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January 2001

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EnterpriseOhio NETWORK

Two Year Campuses in Partnership – Making Learning for the Workplace Count

Information Technology Skills

Ohio Employers' Labor Demand

Implications for EnterpriseOhio Network Campus-wide Leadership

January 2001

The EnterpriseOhio Network presents this special report in service to the administrators and staff members of Ohio's public two-year campuses, the affiliates of the Network. The purpose of this report is to inform and advise the development and operation of campus-wide Information Technology education and training programs. Each EnterpriseOhio Network two-year campus seeks to provide Information Technology education and training programs that are increasingly responsive to the needs of its employer- and employee-customers and the community at large.

The Joint Center for Policy Research (JCPS) of Lorain County Community College researched and produced this report for the EnterpriseOhio Network. Lorain County Community College is an affiliate of the EnterpriseOhio Network. Shara Davis is the Director of the Joint Center for Policy Research. The Ohio Board of Regents' Workforce Development office sponsored the project to develop this report. The EnterpriseOhio Network Professional Development Resource Center at Lakeland Community College disseminates it.

Foreword

Since the formation of the EnterpriseOhio Network in 1986, the Network's 53 public two-year campuses have grown steadily in their capacity to serve Ohio employers and employees with a variety of training, assessment and related services for business improvement. The growth in service of individual EnterpriseOhio Network campuses and the Network at large is in great part a result of the collaboration among affiliated campuses. That's why our EnterpriseOhio Network campuses are "Two Year Campuses in Partnership -- Making Learning for the Workplace Count."

The campuses of the EnterpriseOhio Network work together on many fronts: the professional development of campus Workforce Development staffs, the marketing of campus services to employers and employees, and action research into the issues and workplace needs of a growing Ohio economy. The resources of Ohio's Productivity Improvement Challenge program and Ohio's Jobs Challenge have fostered the remarkable growth of the EnterpriseOhio Network and its fifty-three affiliated two-year campuses as premier Workforce Development service providers to Ohio employers and employees.

Ohio's employers have expressed a growing concern about the shortage of Information Technology (IT) skills among workers. In direct response the EnterpriseOhio Network took action. The Network initiated intensive action research into the details of Ohio's IT skills shortage, the IT needs of Ohio's employers, and the growing capabilities of Ohio's two-year campuses to remedy that shortage of skills. The Network sought to understand the IT skills needs of Ohio employers and employees, the customers of the EnterpriseOhio Network campuses.

This special report was prepared for the EnterpriseOhio Network by the Joint Center for Policy Research of Lorain County Community College under the leadership of its Director, Shara Davis. This report will inform and advise the development and operation of Information Technology education and training programs on EnterpriseOhio Network campuses. As always, those public two-year campuses of the Network seek individually and concertedly to be well-informed, quickly responsive and consistently reliable providers of workforce development services to Ohio's employers and the workforce.

Additional copies of this special report are available from the EnterpriseOhio Network Professional Development Resource Center at Lakeland Community College: Phone (440) 975-5744; Email phoyt@lakeland.cc.oh.us; Fax (440) 975-4744.

Michael C. Taggart, Director
Workforce Development
Ohio Board of Regents
January 2001

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PROJECT OVERVIEW

INTRODUCTION:

On behalf of the EnterpriseOhio Network, the Ohio Board of Regents' Productivity Improvement Challenge Program awarded a competitively earned contract to Lorain County Community College, a Network affiliate, to conduct an action research project in collaboration with the 52 other public two-year campuses of the EnterpriseOhio Netowork. The market research and development project was initiated to develop new strategies for meeting key human resource needs of Ohio employers, primarily the demand for qualified Information Technology workers. This project, managed by Lorain County Community College's Joint Center for Policy Research (JCPR), examined the IT needs of Ohio employers as well as the current and planned responses of EnterpriseOhio Network campuses in responding to marketplace demands. The intent was to enable the two-year system of higher education in Ohio to develop a shared understanding of employer needs and then identify and pilot the most promising opportunities for new service delivery to their employer-customers.

Given the enormous amount of attention devoted to Information Technology, both nationally and in the state of Ohio, this project was intended not to increase the milieu of information available but to build upon existing knowledge. Specifically, the market research addressed:

- What is currently known about the extent and nature of IT labor shortages?
- Based on existing knowledge, what questions are left unanswered relative to producing a quality supply of IT workers?
- What does deeper exploration tell us about unanswered questions and IT needs/demands among Ohio employers?
- What do current and planned responses of the EnterpriseOhio Network look like in relation to marketplace needs?
- What are the gaps and opportunities for new service delivery among the two-year system of higher education?

RESEARCH APPROACHES:

To accomplish this important work, a variety of research approaches were utilized. First, JCPR conducted a comprehensive **national literature review** on the extent and nature of IT labor shortages. The review of literature was conducted for multiple reasons. Knowing that investments had already been made to establish initiatives to move the state forward in it's transformation to a knowledge economy, like the itWORKS.OHIO initiative of the Ohio Board of Regents and the state Department of Education, the EnterpriseOhio Network clearly wanted to contribute to a broader understanding of Information Technology, not to duplicate progress already made. The literature review served as one tool for identifying what is currently known about the extent and nature of IT labor shortages as well as existing responses to IT challenges in the state of Ohio . In addition, a framework needed to be established for building upon existing knowledge to drive deeper exploration of related issues. In essence, the knowledge gained from the literature review was used by the research team to frame questions and research instruments for primary data collection efforts. Most important, information gleaned from the literature review has been packaged to help develop a shared understanding of market demands within the EnterpriseOhio Network which is greatly diverse in terms of the size and nature of campuses it represents. It was envisioned that only with a common language and shared understanding could the Network begin to embark on new service delivery opportunities that were carefully matched with marketplace demands.

Somewhat related to the literature review, the Joint Center for Policy Research also conducted an **environmental scan** of Ohio to gather any studies that had been conducted in recent years on the extent and nature of IT labor shortages. Many of the larger Chambers of Commerce and the Urban Centers of the Ohio Urban University Program were targeted given their track record for data collection in areas of workforce and economic development. Some of the IT professional associations, like Software Associations, and some of the public-private partnerships working to increase the quantity and quality of IT workers in Ohio were also contacted. While more than forty contacts were made, the scan produced only four IT job vacancy studies which had been completed in recent years.

In addition to the national literature review and the environmental scan of job vacancy studies, a **secondary data analysis** was conducted on both supply and demand for IT workers. On the demand side, sources of data from government occupational projections, permanent/temporary labor certificates for IT positions, IT unemployment rates, and other areas were reviewed and analyzed by economic development region within Ohio. On the supply side, a trend analysis of Ohio compared to the U.S. was conducted using data from the *National Center for Education Statistics*. The overall intent was to determine historical patterns of IT worker production for Ohio and to assess gaps in the production of workers compared to the U.S.

Once the literature review, secondary data analysis, and environmental scan were completed, the Joint Center conducted twelve **focus group discussions by targeted industry** to gauge employer reactions to initial findings of the research. For example, a framework of IT-related work resulted from the national literature review. Ohio employers were then asked to discuss their hiring needs and demands within this particular framework. In addition, the literature review produced three overall strands of IT skill

requirements which Ohio employers were asked to comment on in terms of their integration into IT instruction and learning among two-year campuses. Ohio employers were also asked what the two-year campuses of Ohio could do to better help them meet key human resource needs around IT.

The focus group discussions were conducted throughout the state, in both rural and urban areas with two-year campuses serving as host sites. Industry sectors and host campuses included:

- Construction (Owens Community College @ Toledo)
- Manufacturing (Edison Community College)
- Manufacturing (Youngstown State College of Applied Science & Technology)
- Trucking/Warehousing (Kent State University @ Geauga)
- Public Utilities/Communications (Owens Community College @ Findlay)
- Retail (Sinclair Community College)
- Banking/Finance (Cincinnati Technical College)
- Health Services (Columbus State Community Coll[illegible])
- Architecture/Engineering (Columbus State Commu[illegible]y College)
- Government & Education(Shawnee State Community College)
- Government (Lorain County Community College)
- Not-for-Profit Organizations (Ohio University @ Zanesville)

The market research and development project was purposeful in utilizing a building block approach for identifying new strategies to meet the needs of Ohio employers. In doing so, a capacity inventory was carefully designed to assess current and planned responses among the two-year campuses of the EnterpriseOhio Network in relation to demand for IT workers. Building upon what was learned from the literature review, environmental scan, secondary data analysis, and focus group discussions, eight overall dimensions of leadership were developed as critical for the EnterpriseOhio Network to serve as a primary IT resource for the state of Ohio. For example, all two-year campuses in Ohio were asked to provide information relating to all IT education/training currently offered in the form of degree programs, certificate programs, non-credit training, and contracted employer/incumbent worker training. These programs were then grouped into categories which mirrored the framework of IT-related work developed through initial stages of this research. The intent was to determine where Network capacity is strong in relation to current and projected hiring demands and where the Network needs to strengthen it's program offerings to better serve employers and job seekers across the state *in ways that match* the needs of employers. Similarly, the trend analysis of supply data revealed that Ohio has lagged the nation in it's ability to attract and graduate minorities from IT education and training programs. Building on these findings, the two-year campuses were asked to comment on any targeted marketing/recruitment or other special efforts, like scholarship programs which would help provide greater education and training opportunities for minorities in Information Technology. These are but a couple of examples of how the development project was rooted in a careful and systematic research process.

RESEARCH APPLICATIONS:

The EnterpriseOhio Network is currently in the process of linking needs and capacity to:

- Business Development
- Marketing/Promotion
- Internal Capacity Building

Findings of this project will be used for business development, or new and expanded service delivery for IT job seekers and for existing/prospective Ohio employers utilizing the resources of the EnterpriseOhio Network. Translating action research findings into educational literature to better inform Ohioans of IT career opportunities, attract more Ohioans into IT careers, and produce a stronger supply of IT workers for Ohio will consume marketing and promotional efforts of the Network. Employers and incumbent workers will also be targeted for marketing/promotion efforts given the capacity and track record of two-year campuses in providing contracted services to these audiences. Where gaps in service delivery are apparent, the EnterpriseOhio Network will also embark on internal capacity building to strengthen service delivery for Ohioans and employer-customers. Overall, the business development, marketing/promotion, and internal capacity building is intended to strengthen economic competitiveness within Ohio, particularly since workforce development is key to retention, attraction, and global productivity among employers. It is also hoped that these efforts will help move Ohioans into promising IT careers which can positively influence job security, earning potential, and overall quality of life for those who make their homes in Ohio.

A RATIONALE FOR CHANGE

The impetus for this project was driven primarily by the impact workforce development in Information Technology has on economic prosperity within the state of Ohio. Multiple benchmarking studies conducted in 1999/2000 have not only portrayed Ohio as lagging other states in the transformation from a manufacturing to a knowledge/information economy, but most attribute Ohio's standing (and relate it's future potential) to "workforce education".

The Progressive Policy Institute's Technology and New Economy Project for example, ranked Ohio 33rd in the U.S. with an average score of 44.8 based on 17 indicators for making a healthy transition to the new economy.[1] Ohio ranked lowest in workforce education at 40th overall. The 17 indicators used for this study were grouped into five overall areas: Knowledge Jobs, Globalization, Economic Dynamism & Competition, Transformation to a Digital Economy, and Technological Innovative Capacity.

Knowledge jobs were measured by the percent of office and managerial/professional jobs as well as workforce education. In this study office jobs were presumed to be "factory floor of the new economy. Managerial/professional jobs as a percent of the workforce were considered given that states with higher levels tend to have more corporate or regional headquarters. Workforce education was measured by weighting educational attainment given that an educated workforce is key to speed and flexibility.

Globalization was measured partially by the share of manufacturing jobs dependent on exports since states with higher levels also tend to have high levels of either high-tech or natural resource exports. The percentage of workers employed by foreign companies comprised the other portion of globalization and was used as an indirect measure of foreign direct investment (FDI).

Economic Dynamism and Competition was measured in terms of "gazelle" jobs or jobs in companies where sales revenues have grown 20% or more for four years straight indicating a state economy that is "dynamic and adaptive". "Job churning" or business start-ups and failures combined as a share of all companies was yet another indicator as less innovative and competitive companies go out of business and more innovative and competitive companies replace them. The value of initial public offerings as a share of gross state product was also used as a measure of "entrepreneurial dynamism".

Transformation to a digital economy was measured by percent of an on-line population, companies creating a web presence for themselves, by "education technology" or the percent of classrooms wired for the Internet, teachers with technology training, and schools having more than 50% of teachers with Email accounts. The use of digital technology in state government was yet another measure of economic transformation.

Technological Innovative Capacity was determined by jobs in high-tech areas, scientists and engineers as a percent of the workforce, patent issues per 1,000 workers, industry research and development investments, and venture capital as a percent of State Gross Product.

Indicators	Ohio Rank	Ohio Score	U.S. Average
Knowledge Jobs:			
Office Jobs	14	20.0%	19.6%
Managerial/Professional Jobs	23	24.6%	24.9%
Workforce Education	40	50.8%	58.5%
Globalization:			
Export Focus of Mfg.	13	20.0%	18.1%
Foreign Direct Investment	17	4.2%	3.9%
Economic Dynamism			
"Gazelle" Jobs	29	14.0%	14.0%
Job Churning	28	2.3%	2.7%
Initial Public Offerings	20	.31%	.42%
Digital Economy:			
On-line Population	28	30.0%	31.0%
Commercial Internet Domains	27	.20	.26
Education Technology	36	1.5	2.0
Digital Government	27	59.4%	60.4%
Tech Innovative Capacity:			
High-Tech Jobs	32	2.7%	4.5%
Scientists & Engineers	26	.37%	.42%
Patents	18	.50	.48
Industry R & D Investment	22	1.4%	1.8%
Venture Capital	29	.06%	.17%

[1] *The State New Economy Index*, Progressive Policy Institute Technology & New Economy Project, Atkinson, Court, & Ward, July 1999.

Overall, Ohio ranked highest in the export focus of manufacturing and in office jobs and lowest in workforce education and education technology. Ohio fell below the midpoint for high tech jobs, venture capital, scientists and engineers, digital government, commercial Internet domains, on-line population, job churning and gazelle jobs. While opportunity for improvement exists in a variety of areas, the EnterpriseOhio Network and other education/training providers are in a position to strengthen workforce education and make an important contribution to the state's transformation to a new economy.

Another benchmarking study conducted by *The Institute of Advanced Manufacturing* revealed that Ohio cities trail "star" cities in the quality of labor supply to support a technology base. Another important contribution, this study found that Ohio cities have a base of technology employment, but are "in danger of losing that base given the slow rate of creating and attracting technology firms".[2]

The Institute of Advanced Manufacturing compared 5 Ohio cities (Cleveland, Cincinnati, Columbus, Dayton, and Toledo) with 19 national benchmark cities to identify opportunity to "strengthen Ohio's technology base". Based on the indicators used, each city was classified as either a: Star Tech City, Mature Tech City, Emerging Tech City, or Low Tech City. First the study looked at employment of small and medium sized tech companies as a percent of the total workforce, of which all Ohio cities except Toledo ranked high, portraying Ohio as a high technology leader. However, the study also examined tech business start-up and attraction and found that Ohio cities are creating and attracting tech firms at a slower rate than most other cities. No Ohio cities ranked above average in either of these areas. Cleveland, Dayton, and Cincinnati, however, were classified as Mature Tech Cities given the above average tech employment, but below average tech attraction. Columbus was ranked as an Emerging Tech City given it's above average tech attraction but below average employment. Toledo was classified as a Low Tech City since it ranked below average in both employment and attraction.

The studied also described four other factors which may contribute to technology success including: Labor, Image, Financing, and Technology. ***Within the labor category, the study found that high tech cities are better educated at every level.*** Ohio trailed the Star Cities by 6% for high school graduation, in associate degrees by 20% and with scientists and engineers a percent of the total population by 65%.

In relation to image, Ohio was described as having "excellent amenities and being touted in the national press as an excellent place to do business". For example, within health and the arts, Ohio cities were generally comparable to, or above, Star Tech Cities. However, the state is not perceived as a high tech state, making it more difficult to recruit technology firms and workers.

Relative to finance, the study found that Star and Emerging cities attract more venture capital than Ohio cities. The picture was even more dismal for technology where Ohio cities generally ranked as Low Tech Cities given that funding for university research in Ohio falls well below other cities.

Recommendations for Ohio were as follows:

- Increase the quality of secondary education, *graduate more students from two-year schools*, and attract scientists and engineers to the state.
- Ohio should strive to develop a reputation as a technology state.
- Ohio needs more seed capital and should focus on the requirements of tech firms at the "pre-venture funding" stage.
- Ohio should support increased funding for university research activities and those of other research organizations within the state.

Other studies too provide a portrait of where Ohio stands and what needs to be done to move the state towards a high-tech economy. *The Milken Institute in it's study on America's High Tech Economy, Growth, Development, and Risks for Metropolitan Areas* for example, revealed that not a single Ohio city ranked in the comparative indexed top 50 'Metro Tech Polls' identified in the published study.[3] Workforce education and labor supply were key themes of many of these studies. Not only does Ohio currently rank low, both describe improvement in these areas as critical to a successful economic transition.

There is substantial evidence that Ohio's future economic stability and prosperity will be determined by our ability to develop and sustain a quality workforce, particularly one that is technologically competent. Given the impressive record of responsiveness to the skill needs of Ohio employers, the EnterpriseOhio Network feels it can make important contributions in helping create and establish this workforce. This project is intended to determine, based on quality data and information, those areas of service delivery that can help move Ohio towards technology excellence and position our state as a technology leader among current and prospective employers.

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[2] *Ohio Cities Technology Benchmarking Study*, The Institute of Advanced Manufacturing Sciences, Inc., July 23, 1999.

[3] America's High-Tech Economy: Growth, Development, and Risks for Metropolitan Areas, Milken Institute, Santa Monica, CA., by Devol, Wong, Catipano, and Robitshek, July 1999.

DEMAND FOR INFORMATION TECHNOLOGY WORKERS

OHIO COMPARED TO THE U.S.

ANALYSIS FRAMEWORK

SECONDARY DATA ANALYSIS
(Government occupational projections, labor certificates, Job vacancy studies, qualitative analysis, industry projections)

FOCUS GROUP DISCUSSIONS WITH OHIO EMPLOYERS

IT DEMAND: OHIO COMPARED TO THE U.S.

SUMMARY OF DEMAND BY PRIMARY IT CLASSIFICATION

IT WAGES & SALARIES: OHIO COMPARED TO THE U.S.

DEMAND FOR INFORMATION TECHNOLOGY WORKERS: ANALYSIS FRAMEWORK

The Computing Research Association (CRA) released a study in 1999 entitled "*The Supply of Information Technology Workers*". Among numerous contributions, this study carefully reviewed and evaluated all sources of data for assessing supply and demand for Information Technology workers. The study group concluded:

> Unfortunately, no one kind of evidence currently available provides a clear or unambiguous answer as to whether there is a shortage . . . The presence of multiple indicators provides better assurance that shortages exist.[4]

CRA's insistence on multiple indicators to gauge the extent and nature of an IT labor shortage is not taken lightly. On behalf of the EnterpriseOhio Network, the Joint Center for Policy Research reviewed more than 100 studies and pieces of literature on this subject. While much information exists, the literature is confusing and study results are often conflicting.

First, there is no common language or consistent framework from which Information Technology is defined and measured. Multiple definitions and classification schemes used to describe IT industries and occupations are common. Federal and state government, for example, emphasize their own sources of industry and occupational projections. The IT occupations used, however, are limited in scope compared to those used by industry professionals. For example, the U.S. Department of Commerce released a report in 1997 entitled "*America's New Deficit: The Shortage of Information Technology Workers*". This report, in conjunction with another study released by the Information Technology Association of America (ITAA), called widespread attention to the shortage of IT workers in the U.S. Both of these studies, however, were limited to traditional occupations used by the Bureau of Labor Statistics (e.g.: Computer Scientists, Computer Engineers, Systems Analysts, and Computer Programmers). Given the expedient evolution of IT and the complexity of IT positions offered by recent private surveys, these classifications are outdated.

In addition, attempts to assess IT shortages are often specific to the interests of those conducting the analysis. Economic development organizations, for example, tend to highlight IT job vacancies among their private-sector membership. But, as described by Dr. Robert Lerman of the Urban Institute:

> The presence of vacancies does not necessarily demonstrate a shortage of workers. A vacancy simply means the firm has an open position it has not yet filled. Vacancies as a proportion of employment will depend on the employers turnover rate, how long it takes to fill a vacancy and the extent to which the company is growing.[5]

IT professional associations, on the other hand, zero in on wage and salary hikes as a sole indicator of worker shortages. Others describe this as a natural market response:

> Generally free markets alleviate shortages through the price mechanism . . . Labor market forces will generally raise relative wages enough to attract workers. In fields involving long lags between the onset of vacancies and the time it takes to train additional workers, rising demand for workers may initially raise wages without bringing additional supply of workers. However, within a few years, the increased wages draw more workers into the field.[6]

Lending further support, *Computerworld Inc.* found through it's surveys of industry professionals that " IT salaries rise significantly in one year as the market adjusts to hiring demands and then immediately flatten out to traditional cost of living increases for the next three years."[7] This means wage and salary hikes alone are not enough to proclaim a widespread shortage of IT workers.

On the supply side, studies examining the production of IT workers have been limited to Computer Information Science degree programs at post-secondary levels, yet there is evidence that IT workers come from a variety of backgrounds and are bread from multiple academic disciplines - both IT and non-IT fields of study.

All of these areas of concentration help to broaden our knowledge and understanding of IT, but only when the data and information is considered as a whole. CRA recommends that any study consider statistical indicators, limited scope studies, anecdotal evidence, and qualitative evidence of labor shortages. ***Statistical indicators*** consist primarily of labor market information supplied by state and federal agencies like industry/occupational projections, permanent/temporary labor certificates, and unemployment rates. ***Limited scope studies*** include wage/salary assessments and job vacancy studies commissioned by economic development organizations, industry professionals, and others. ***Anecdotal evidence*** refers to the incidence of market response measures like increased recruiting (companies and campuses), overtime for IT workers, reducing minimum qualifications, restructuring work, outsourcing or contracted IT work, incumbent

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[4] The Supply of Information Technology Workers in the United States, Freeman and Aspray, The Computing Research Association, 1999.

[5] "*The Labor Market for IT Workers*", Dr. Robert I. Lerman, The Urban Institute, Testimony before the Subcommittee on Immigration, U.S. Senate, February 25, 1998.

[6] Lerman, The Urban Institute, 1998.

[7] "*Two years after IT salaries and bonuses skyrocketed to record highs, managers report again they have put a stop to the madness giving 'traditional' increases to all but a prized few*", Bronwyn Fryer, Computerworld Inc., 1999.

worker retraining, improved work processes (flex hours and other non-wage conditions to attract/retain workers); and sign on bonuses, etc. *Qualitative evidence* is non-statistical information which includes increased concern among education/training providers, professional associations, government agencies, and others often leading to public -private partnerships to improve the quantity and quality of workers.[8]

Building on the work of CRA, multiple indicators have been reviewed to gauge the extent and nature of IT labor shortages for Ohio. These indicators include:

- Government Employment Projections
- Permanent/Temporary Labor Certificates
- Chamber of Commerce Job Vacancy Studies
- Focus Group Discussions with Ohio Employers
- Presence of Public-Private Partnerships to Improve the Supply of IT Workers
- Private Survey Data on IT Wages and Salaries

It is also important to note that IT is an area particularly prone to short-term demand. *The Computing Research Association* recommends that we distinguish types of labor demand, particularly short-term or "episodic" demand versus that which reflects fundamental shifts in the economy:

> There are many kinds of shortages. They may be specific to one geographic region or to a sub-specialty within a labor market. They may be episodic - created by a one-time phenomenon of limited duration like Y2K or the Euro-Conversion - or [they may be] more enduring.[9]

For this reason, the EnterpriseOhio Network market research and development project probed Ohio employers on the future of IT labor shortages. All the evidence of IT workers shortages presented in this chapter need to be weighed in a comprehensive manner with particular attention on the *nature* of demand, not just the extent. In doing so, new service delivery among The EnterpriseOhio Network will have more meaningful impact on overall economic competitiveness for it's employer-customers and for those Ohioans who pursue a career in areas of IT specialty.

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[8] CRA, 1999.

[9] CRA, 1999.

DEMAND FOR INFORMATION TECHNOLOGY WORKERS IN OHIO:
SECONDARY DATA ANALYSIS

❖ KEY FINDINGS ❖

Government Projections:
According to government projections, the demand for IT workers in Ohio appears to be strong and only slightly lower than the U.S.

In Ohio, the greatest number of jobs in 1996 were for Systems Analysts and this occupation is expected to generate the most new jobs to 2006.

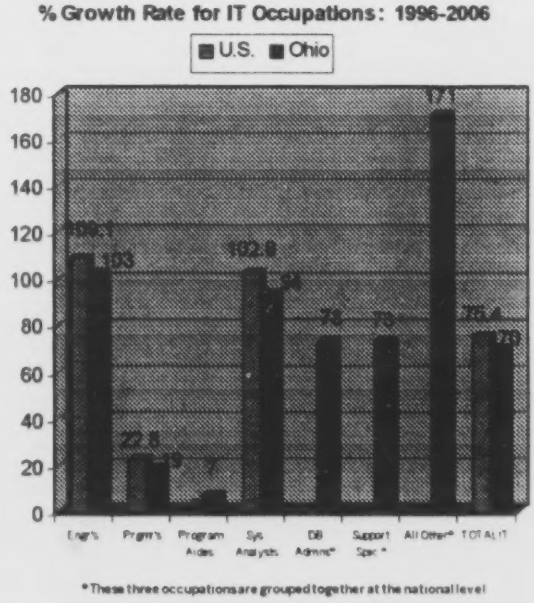
Labor Certificates:
The proportion of all *permanent* labor certificates provided for IT positions was actually higher in Ohio than the U.S. The greatest share of these certificates were provided for Software Engineers in both Ohio and the U.S.

In 1998, 11,479 temporary labor certificates were provided for IT workers in Ohio of which 10,791 were for Systems/Program Analysts alone.

Job Vacancy Studies:
The greatest demand among IT enterprises in NE Ohio was found for Programming Analysts, Network Specialists, and Software Engineers. Among large companies, Programmer/Analysts, Network Specialists, and Technical Support Representatives were in greatest demand.

Greatest demand for IT workers in the Greater Columbus region (using unpublished data) was for Programmer/Analysts, Information Support Services, and Network Systems personnel.

Qualitative Evidence:
Many public-private partnerships have been formed throughout Ohio to improve both the quantity and quality of IT workers, providing some evidence that labor shortages are a reality for our state.



*These three occupations are grouped together at the national level

GOVERNMENT EMPLOYMENT PROJECTIONS:

When government-based occupation projections are considered, the demand for IT workers in Ohio appears to be strong and only slightly lower than the U.S. Nationally, the growth rate for all IT occupations between 1996 and 2006 is 75.4%. This figure is only slightly lower for Ohio at 70%. Growth rates are also comparable when IT occupations are considered separately. For example, the projected growth rate for Computer Engineers at the national level is 109% and is 103% for Ohio. Similarly, System Analysts are expected to grow at a rate of 103% nationally and by 94% in Ohio. Computer Programmers also show a comparable rate of growth for Ohio and the nation at 19% and 23% respectively. Unfortunately, data is grouped together at the national level for Database Administrators, Computer Support Specialists, and All Other Computer Scientists making comparisons to Ohio difficult for these occupations.

In addition to growth rates, actual numbers of jobs in are important to our understanding of the demand for IT workers. First, percent change (or growth rates) can be high when the actual numbers of jobs are actually low. In addition, comparing absolute numbers of jobs (and growth rates) with other professional specialty occupations can provide insight to IT job growth within a comparative context. Some secondary sources, for example, indicate that the demand for IT jobs is not much different than what we have experienced in other professional specialty areas.[10] This helps to clarify the actual extent of an IT labor shortage. Absolute number of jobs are also important for determining the number of workers needed for IT positions over time.

In reviewing the numbers of IT jobs that currently exist according to government sources, the following is evident:

- Nationally, the greatest number of jobs have been in Computer Programming (568,000 positions in 1996). In Ohio, however, the greatest number of jobs have been for Systems Analysts (22,190 in 1996).

[10] Lerman, The Urban Institute, 1998.

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- While Computer Engineers have the highest growth rate to the year 2006 for both Ohio and the U.S. (excluding the All Other categories), the actual number of jobs in 1996 were low in comparison to Programmers and System Analysts. (Nationally there were 216,000 Engineer positions compared to 568,000 Programmers and 506,000 System Analysts. In Ohio there were 5,540 Engineer positions compared with 22,190 System Analysts and 15,720 Programmers).

With respect to projected numbers of jobs, the following is evident:

- For both Ohio and the U.S., the greatest number of new jobs are expected for Computer Systems Analysts (an additional 519,000 in the U.S. and an additional 20,760 in Ohio). No other occupation is expected to experience near the number of new jobs that System Analysts are.

- Nationally, the second largest category of new job openings are likely to occur in the broad cluster of Database Administrators/Support Specialists/All Other Scientists, Data Communication Analysts positions (+249,000). In Ohio, the second largest number of new jobs are projected for Computer Engineers (+5,690).

- Computer Programmers are among the IT occupations to experience the lowest number of new jobs to the year 2006 (+129,000 nationally and +3,030 in Ohio) but it is also important to consider that a strong base of these positions existed in1996.

NATIONAL IT Employment Projections

IT Occupation	1996 Employ.	2006 Projected Employ.	Change in Employ. 96-06	Percent Change 96-06
Computer System Analysts	506,000	1,025,000	519,000	102.8
Database Admin; Computer Support Specialists; All Other Computer Scientists & Data Communication Analysts	212,000	461,000	249,000	117.8
Computer Programmers	568,000	697,000	129,000	22.8
Computer Engineers	216,000	451,000	235,000	109.1
TOTAL IT	**1,502,000**	**2,634,000**	**1,132,000**	**75.4**

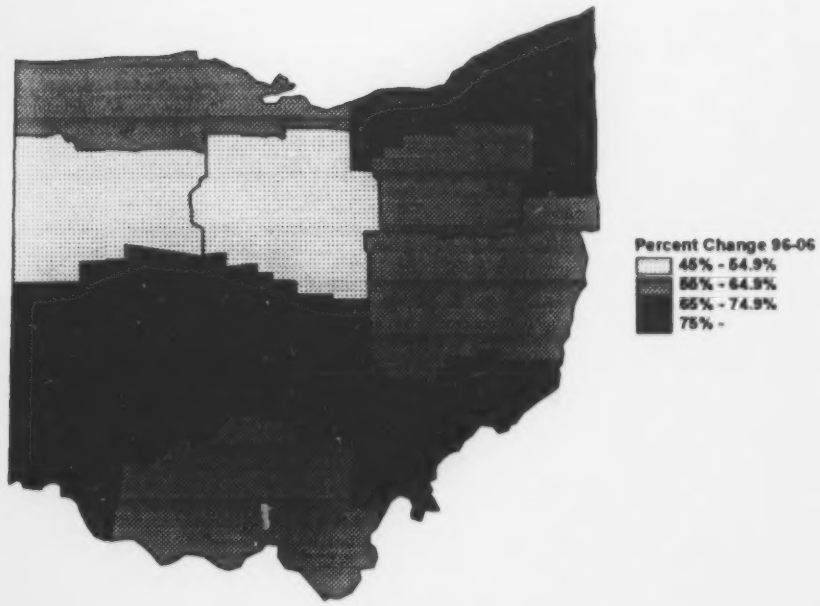
OHIO IT Employment Projections

IT Occupation	1996 Employ.	2006 Projected Employ.	Change in Employ. 96-06	Percent Change 96-06
Computer System Analysts	22,190	42,950	20,760	93.6
Database Admin.	1,440	2,490	1,050	72.9
Computer Support Specialist	4,270	7,400	3,130	73.3
Computer Programmers	15,720	18,750	3,030	19.3
Computer Programmer Aides	3,300	3,530	230	7.0
All Other Computer Scientists; Data Communication Analysts	2,790	7,570	4,780	171.3
Computer Engineers	5,540	11,230	5,690	102.7
TOTAL IT	**55,250**	**93,920**	**38,670**	**70.0**

Within the state of Ohio, an analysis of IT employment was conducted by economic development region. In 1996, the greatest number of IT jobs were found in regions 1, 8, 5, and 4 or the urban areas of Columbus, Cleveland, Cincinnati and Dayton. Most job openings will also occur in these four areas to the year 2006. However, it is regions 1 and 4 (Columbus and Dayton areas) that are expected to have the greatest growth rate in IT jobs over this ten year period.

OHIO IT Employment Projections By Economic Development Region

Ohio Economic Development Region	1996 Employ.	2006 Projected Employ.	Change in Employ. 96-06	Percent Change 96-06
1	13,834	24,891	11,057	79.9
2	2,546	4,013	1,467	57.6
3	1,078	1,567	489	45.4
4	7,009	12,611	5,602	79.9
5	9,259	15,417	6,158	66.5
6	1,563	2,349	786	50.3
7	572	942	370	64.6
8	12,159	20,318	8,159	67.1
9	4,669	7,595	2,926	62.7
10	1,042	1,672	630	60.4
11	339	575	236	69.7
12	1,179	1,971	792	67.1



1998 PERMANENT & TEMPORARY LABOR CERTIFICATES FOR IT WORKERS:

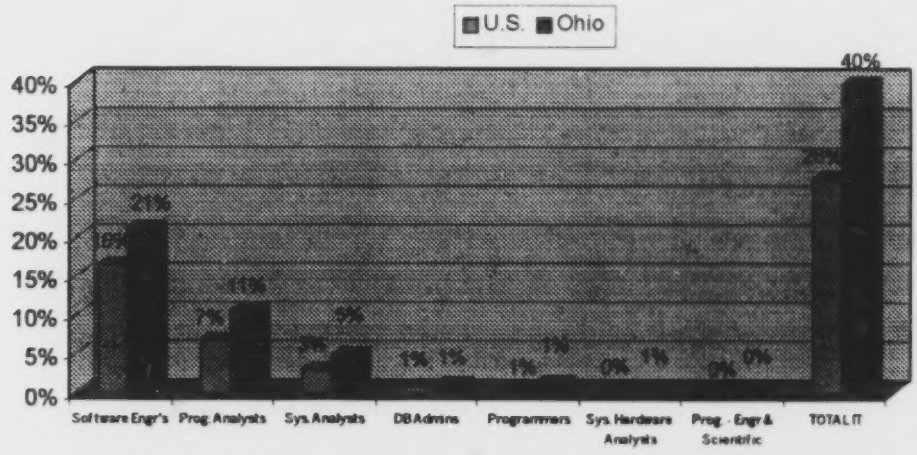
There is an assumption that in a shortage situation employers will recruit workers outside of the U.S. to satisfy their unmet need for workers. In fact, incentives for permanent and temporary labor certificates to foreign workers have been considered as a matter of government policy to ease shortages of workers and to maintain economic stability among U.S. companies. A secondary analysis of data reveals that the proportion of all *permanent* labor certificates provided for IT positions were actually higher in our state compared to the nation. The proportion of *temporary* VISA's certified to IT workers for Ohio were, however, very similar to the U.S. It is, however, the number of temporary VISA'S for IT positions in Ohio that have been significant in recent years.

With respect to permanent labor certificates, 40% of all certificates in Ohio were awarded for IT-related positions compared to 28% of all certificates nationally. The greatest share of permanent labor certificates in both Ohio and the U.S. were awarded for Software Engineers (21% and 16% respectively). In Ohio, the total number of permanent certificates for this occupation totaled 79 in 1998. Programmer Analysts represented the second largest position for which permanent labor certificates were offered in Ohio (10.5%) and the U.S. (6.7%). The total number of permanent certificates in this area was 39 for Ohio in 1998.

IT-related positions constituted an even greater share of H1-B temporary VISA's. In Ohio, 59% of all temporary certificates were offered for IT positions. This figure was at 60% for the nation. Most temporary certificates were offered for Systems/Program Analysts in both Ohio (55%) and the U.S. (55%). In Ohio, this constituted 10,791 positions alone. Other Computer Related Occupations offered in 1998 totaled 482. Overall 11,479 *temporary* certificates were offered in Ohio compared to a total of 148 *permanent* labor certificates in the same year. The fierce demand for Systems/Program Analysts was likely related Y2K compliance needs, especially since most of the certificates were temporary in nature.

Research conducted by Cuyahoga Community College, an EnterpriseOhio Network campus, revealed similar patterns of demand for IT workers into 1999. This research showed that 291 *Northeast* Ohio employers submitted applications for 668 workers in the first five months of 1999 to fill unmet demand for trained IT workers. This work also analyzed job postings on America's Job Bank (AJB) from May to September 1999, revealing that there were 1,039 IT related positions within a 50 mile radius of downtown Cleveland. This data makes government projections appear conservative.[11]

1998 % Permanent Labor Certificates for IT Workers (Ohio compared to U.S.)



Source: Dept. of Labor, Employment & Training Admin., Alien Labor Certification Program

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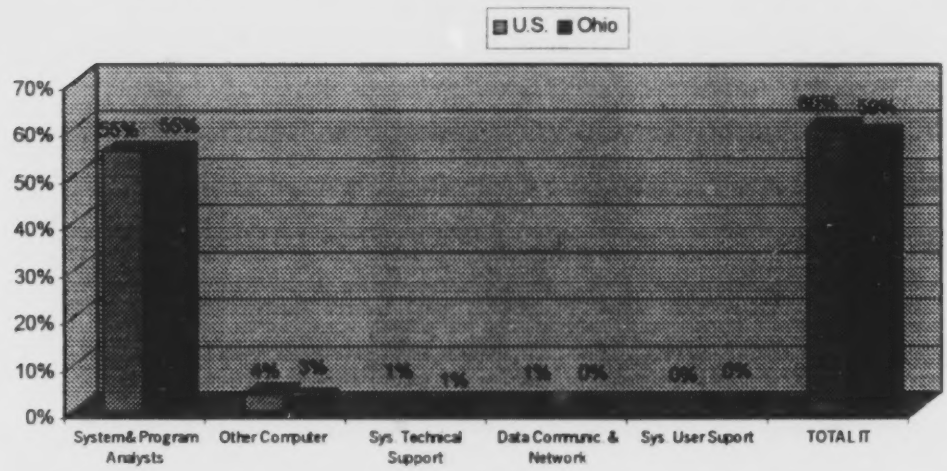
[11] Warren Webb, Cuyahoga Community College, 1999.

1998 % H1-B (Temporary Visa's) Certified to IT Workers (Ohio compared to U.S.)



Source: Dept. of Labor, Employment & Training Admin., Alien Labor Certification Program

JOB VACANCY STUDIES:

OHIO's GREATER CLEVELAND

The Jobs and Workforce Initiative of the Greater Cleveland Growth Association released a study in 1999 which identified demand for IT workers within particular industry segments. The two primary targets were IT enterprises (i.e., suppliers of IT products and services) and large establishments where IT was not the primary product or service but the company made "significant use of IT professionals or had a separate IT/MIS department to satisfy it's needs". Two separate mailings were conducted. The Growth Association indicated that the "intent of the surveys was not to identify total regional demand for IT workers" but rather to demonstrate level of demand within these two industry targets.

Among the IT enterprises, survey results revealed the majority of IT suppliers had fewer than 5 vacant IT positions. However, 15% had 12 or more vacancies and 40% projected 9 or more additional IT openings within 18 months. A total of 252 vacant positions and an additional 683 vacancies were projected for the 66 responding IT firms alone. This too provides some evidence that government sources are conservative in their projections of IT job openings to the year 2006.

The greatest demand among IT enterprises in Northeast Ohio was found for Programming Analysts (268 current and projected), Network Specialists (126 current and projected), and Software Engineers (122 current and projected). Other areas of growth were noted for System Analysts (91 total openings), Technical Support Representatives (79 openings), Data Base Administrators (78 openings), and IT Managers (65 openings). The least number of openings were reported in Information Systems Operation and Analysis. Some new professions described by IT Enterprises included IT Sales, Graphic Artists, Business Analysts, and Bioinfomatics.

Among the IT-enabled larger firms, a total of 148 current vacancies and an additional 138 IT vacancies were expected over 18 months. The nature of demand among larger non-IT firms was similar to that of IT suppliers. Programmer/Analysts, Network Specialists, and Technical Support Representatives were among the occupations in greatest demand. The only difference between the target industries was for Software Engineers which appear to be in demand for IT Enterprises but not the larger non-IT firms.

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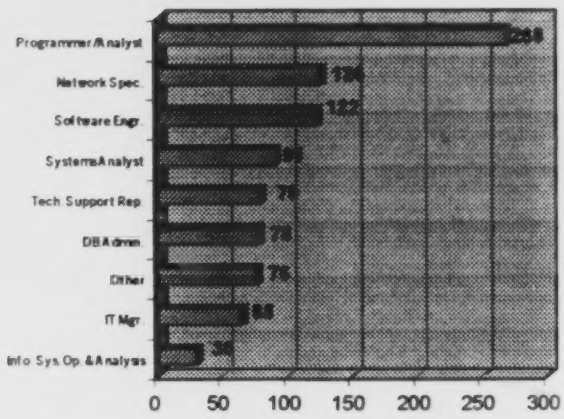
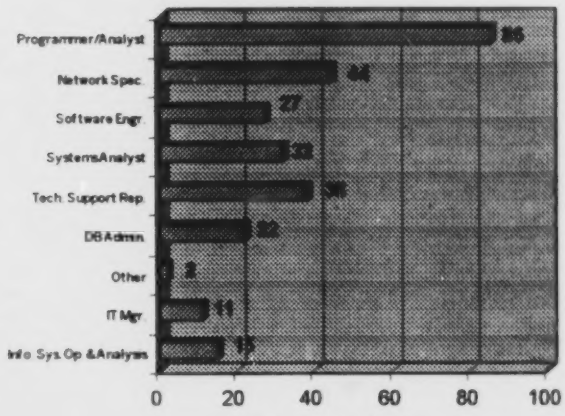
Nature of IT Job Vacancies Among **IT SUPPLIERS** in Greater Cleveland (Number of Current & Projected Over 18 Months)



Information Technology Survey, by Keeney,Kleinhenz, Petrie, Robey, Greater Cleveland Growth Association, 1999

Nature of IT Job Vacancies Among **IT ENABLED LARGE FIRMS** in Greater Cleveland (Number of Current & Projected Over 18 Months)



Information Technology Survey, by Keeney,Kleinhenz, Petrie, Robey, Greater Cleveland Growth Association, 1999

experienced an annual turnover rate of 10% or less. Interestingly, the primary reason for IT turnover for both industries was attributed to workers leaving for higher wages and benefits.

With respect to recruitment, hiring, and training practices both groups were asked if they administer objective skill assessment tests to prospective employees. Eighty-one percent of the IT enterprises indicated they do not administer these tests but 38% said they would be interested in assistance with personnel testing. Similarly, 82% of the large IT-enabled companies did not administer tests, but only 12% said they would be interested.

A little more than one half (54%) of all IT enterprises would be interested in programs to recruit outside workers and 57% would be willing to participate in programs to train local IT workers. About one half (53%) of IT-enabled large employers also said they would be interested in programs to help recruit outside workers and 41% would be willing to participate in training programs for local workers.

	IT Suppliers	Large IT-Enabled Firms
Annual Turnover Rate	12%	11%
Primary Reason for Turnover	Higher Wages/Benefits	Higher Wages/Benefits
Use Assessment Tests	19%	18%
Interested in Assistance with Personnel Testing	38%	12%
Interested in Program to Recruit Outside IT Workers	54%	53%
Willing to Participate in IT Training Program for Local Workers	57%	41%

Information Technology Survey, by Keeney, Kleinhenz, Petrie, Robey, Greater Cleveland Growth Association, 1999.

In addition to job vacancies, the greater Cleveland surveys assessed turnover rates and recruitment, screening, hiring practices among IT suppliers and IT enabled large employers. In both target industries, zero was the most common response related to annual turnover of IT workers. However, an overall turnover rate of 12% and 11% were experienced by IT enterprises and the larger companies respectively. Two-thirds (67%) of the IT enterprises had an annual turnover rate of 10% or less while 53% of the larger IT-enabled companies

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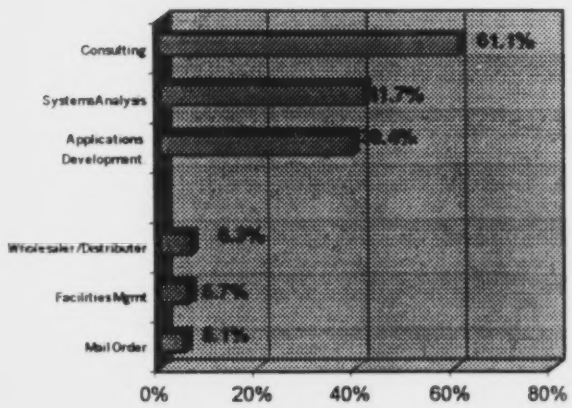
OHIO's GREATER DAYTON

The Center for Urban and Public Affairs at Wright State University in Dayton, Ohio conducted a similar survey to the greater Cleveland area in 1999. A total of 285 IT firms were surveyed of which 176 companies responded for an overall response rate of 62%. IT firms were separated into two categories: (1) the "pure IT firms wherein the product/service provided is computer related, engineering, research and development and/or IT consulting" and (2) "firms which use IT in its processes to develop non-IT products". The intent of the survey was to create a directory of IT firms within the Greater Dayton area which detailed areas of IT business activity and specific product/service mix for each firm. The directory is being used to promote networking within the regional IT industry, as well as to market the IT strengths of this region. While job vacancy data was not provided, the common areas of IT activity were described.

The most common area of business activity within this region of the state was described as IT consulting (61%). "Many firms also provide systems analysis (41.7%), applications development (39.4%), customer service/support (38.3%), and project management (37.7%).

Three Most/Least Common Areas of IT Business Activity in Greater Dayton



Ohio's Greater Dayton Information Technology Industry Data Summary, The Center for Urban and Public Affairs, Wright State University, 1999

OHIO's GREATER COLUMBUS

While no official report was released, the *Greater Columbus Chamber of Commerce* conducted a survey of it's membership to assess need for skilled Information Technology workers. While only 15 businesses responded to the survey, there were some similarities in findings to the study conducted by the Greater Cleveland Growth Association in Northeast Ohio. The greatest number of IT jobs are currently in Programmer/Analyst/Software Engineers, Information Support Services, and Network Systems. However, the demand for Programmer/Analysts/Software Engineers is not expected to grow much according to these firms. These are also the areas considered most important to business operations. While there appear to be much fewer jobs for Database Administrators, this occupation was among the most important to fulfilling business obligations. The least amount of demand was reported for Interactive Digital Media Specialists.

Need for Skilled IT Workers in Greater Columbus	Current # Employees among 15 companies	# Projected Employees 3 Years From Now	Importance to Business Operations (1-4 scale)
Programmer/Analyst /Software Engineers	308	308	3.64
Information Support & Services	131	153	3.45
Network Systems	102	122	3.78
Database Administrators	22	33	3.75
Interactive Digital Media Specialists	10	17	2.42

OHIO'S GREATER CINCINNATI

The Institute for Policy Research at the University of Cincinnati conducted a telephone survey of employers in 1999 on behalf of the Greater Cincinnati Chamber of Commerce. "The purpose of the survey was to explore how the Chamber of Commerce could better serve the technological needs of its members". While most of the survey was focused on e-commerce activity, businesses were asked about their likelihood of purchasing training on "how to use the Internet for business related information" and on "selling products and services over the Internet". In addition, employers were asked about potential new service needs. The results may provide some insight to service delivery opportunities, including contracted training options, for The EnterpriseOhio Network:

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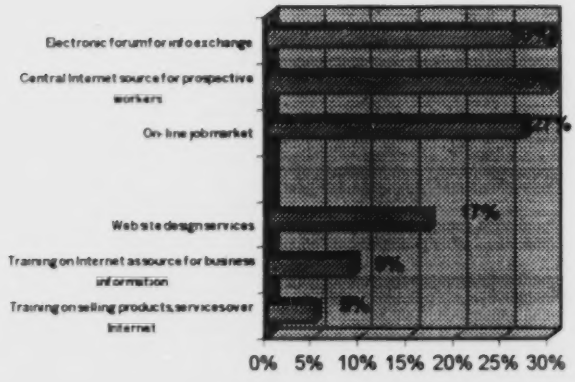
- About17% of businesses indicated they were extremely or very likely to purchase web site design services. Small companies (15 employees or less) were not as likely as larger companies to purchase these services.
- Only 5% of all businesses were extremely or very likely to purchase training on selling products and services over the Internet. Small companies were not as likely to purchase these services as were larger companies.
- Approximately 9% of companies were extremely or very likely to purchase training on how to use the Internet as a resource for business related information. The percentage of companies that would *not* purchase these services was also highest among small establishments.
- An electronic forum for business people to exchange information about problems and common solutions was considered very important by 30% of all companies.
- A central Internet sources of information about the area for prospective workers who are thinking about relocating to Cincinnati was also considered very important by 30% of companies surveyed.
- An on-line job market for prospective employees and employers was described as very important by 27% of all businesses.

Training & Service Delivery Needs Among the Greater Cincinnati Business Community



Greater Cincinnati Chamber of Commerce Technology Survey, Institute for Policy Research, University of Cincinnati, August 1999

QUALITATIVE EVIDENCE OF IT DEMAND IN OHIO:

As indicated, public-private partnerships among education/training providers, professional associations, government agencies, and others provide qualitative evidence that worker shortages are of primary concern given the collaborative investments made to improve both the quantity and quality of workers within particular geographic areas. As a part of this comprehensive analysis, the Joint Center scanned the state to identify some of the existing and emerging partnerships of this nature. Based on the quantity of these partnerships, there is no doubt that a the supply of IT workers is of concern for a variety of stakeholders across the state of Ohio. Some of the larger, regional efforts include:

Central Ohio IT Alliance (ITA) was created by the Industry and Technology Council of Central Ohio to support the growth and development of the IT industry. The organization is an affiliate of the Ohio IT Alliance, ITC, and the Greater Columbus Chamber of Commerce. Software business incubator and programs are currently available.

Dayton IT Alliance is the greater Dayton region's only organization dedicated to the growth of the information technology industry.

Greater Cincinnati Software Association was established to initiate changes in the local business climate encouraging growth in the local software industry throughout the tri-state area.

Industry & Technology Council of Central Ohio (ITC) acts as a catalyst to encourage and foster the initiation and growth of technology based companies, and the effective use of technology by companies in central Ohio in order to diversify and strengthen the regional economy. ITC is an affiliate of Ohio's IT Alliance and the Greater Columbus Chamber of Commerce.

IT Alliance of Northeast Ohio (ITANO) is the northwest Ohio region's only organization dedicated to supporting the retention, growth, and economic development of its IT industry. ITANO is a partner in Ohio's IT Alliance.

ItWorks Ohio is a "broad based educational response to Ohio's need for a skilled information technology workforce. It is intended to assist educators and their business partners in developing courses and implementing training programs that prepare students for successful information technology careers".

Northeast Ohio IT Skills Alliance is currently an initiative of the Greater Cleveland Growth Association which has received support to under take a year long planning process to fully develop the organization.

Northeast Ohio Software Association (NEOSA) is a private industry trade association formed in 1998 as a not-for-profit 501(c)(6) Ohio corporation. The association serves as a clearinghouse for the IT industry encouraging and facilitating communication between the industry, service providers, educational institutions, and economic development organizations.

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Ohio's IT Alliance is an Edison network suporting information technology growth in the state of Ohio. It is focused on growing and retaining Ohio's extensive IT industry. The organization is an IT industry-driven, non-profit strengthening Ohio's presence in the rapidly developing IT business environment.

Regional Business Council(RBC) is a coalition of major business leaders providing a private-sector approach to economic development in the 18 county northeast Ohio region. RBC focuses on three priority issues including technology based business development and workforce development coordination.

IIT INDUSTRY PROJECTIONS:

In addition to occupational projections, the Computer and Data Processing Services Industry is yet another source from which to monitor the growth of IT in Ohio compared to the U.S. The number of these establishments in the U.S. increased by 43,120 between 1993 and 1997. This represented an increase from .981% of all business/industry to 1.53% in just five years. Ohio witnessed similar increases during this time. The total number of Computer and Data Processing establishments grew by 1,195 signifying an increase from .81% of all business/industry to 1.21% over the same period.[12]

"Over the past ten years in Ohio, the growth in payroll for SIC 737 (computer programming, data processing, and other computer related activities) has been almost 10% per year, the highest rate for any industry in the state. Approximately 57% of the firms in SIC 737 are in computer programming services, prepackaged software, and computer integrated systems design which are the areas that have been showing the greatest growth on a national level".[13] Employment in this industry is expected to grow by 6% per year over the next eight years.

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[12] U.S. Bureau of the Census, County Business Patterns.

[13] Ohio's Greater Dayton Information Technology Industry Data Summary, Center for Urban and Public Affairs, Wright State University, 1999.

DEMAND FOR INFORMATION TECHNOLOGY WORKERS:
FOCUS GROUP DISCUSSIONS WITH OHIO EMPLOYERS

❖ KEY FINDINGS ❖

Somewhat different from secondary sources which describe software engineers and programmers/analysts in greatest demand, focus group discussions reveal the need for Network Specialists and Computer Support, Maintenance, Repair is greatest *across all industry sectors of Ohio.*

Systems/Product Development and Integration Specialists (like Programmers and Systems Analysts) are in demand by *large establishments, not small/medium sized employers* which comprise a greater share of today's economy.

Digital Media Technology, particularly Web Designers will be in greater demand as E-commerce continues to grow across Ohio. This could, however, be an area of shorter term demand as in-house personnel are anticipated to maintain Web functions once initial design is completed.

Database Administrators are also re-emerging as an area of demand in Ohio.

Most hiring of IT workers will continue at the corporate office level while out-sourcing of IT work will continue among local offices.

Ohio employers will offer flexible work hours and tele-commuting as incentives for attracting IT workers.

Increased demand and worker burnout are anticipated to drive future shortages yet most believe future shortages will be offset by the emergent workforce which is perceived to be more technologically literate.

On behalf of the EnterpriseOhio Network, the Joint Center for Policy Research conducted twelve focus group discussions with Ohio employers. Each of the groups were convened around key target industries utilizing the resources of Ohio's two-year campuses:

- Construction (Owens Community College @ Toledo)
- Manufacturing (Edison Community College)
- Manufacturing (Youngstown State College of Applied Science & Technology)
- Trucking/Warehousing (Kent State University @ Geauga)
- Public Utilities/Communications (Owens Community College @ Findlay)
- Retail (Sinclair Community College)
- Banking/Finance (Cincinnati Technical College)
- Health Services (Columbus State Community College)
- Architecture/Engineering (Columbus State Community College)
- Government & Education(Shawnee State Community College)
- Government (Lorain County Community College)
- Not-for-Profit Organizations (Ohio University @ Zanesville)

Employers were asked a series of key questions to explore the driving forces of technology, IT labor demands, and the future of IT. Specifically, employers were asked:

- Overall, what is driving technology use and applications within your sector?
- Think about where you're currently at technologically and where your company/organization envisions it must be a couple of years from now. How will this impact your need for skilled information technology workers?
- We'd like to share with you a framework for IT-related work. In which of these areas do you believe most establishments, small and large, within your sector will need to hire IT workers over the next couple of years and why? And, which of these areas of skilled work are likely to be out-sourced to consultants or independent contractors and why?
- How has recruitment and retention of IT workers compared to other positions within your company/organization? Similarities? Differences?
- Some believe IT worker shortages are short lived because they are driven by episodes like Y2K. Do you think shortages of IT workers, meaning the supply of workers will not be enough to satisfy employer demands, is likely to continue or not? What might drive future shortages?
- What might your company/organization be willing to do to find and attract IT workers over the next couple of years?

The framework of IT-related work provided to employers was devised by JCPR based on the comprehensive review of literature. The

FRAMEWORK OF IT RELATED WORK:

Definition: Any worker engaged in the design, study, development, implementation, management, and support of computer-based information systems.

Computer Systems Support, Maintenance, & Repair

Networking Technology (Network Specialists)

Digital Media Technology (Multi-Media Specialists)

Systems or Product Development & Integration
- Database Development, Management, Warehousing
- Systems Development & Integration
- Software Engineering

Technology Directors

framework includes a widely accepted definition of IT workers and five overall classifications of IT related work. The broad classification of "Systems or Product Development & Integration" can be broken into three separate areas of IT work. Employers were also provided with a list of specific jobs within each of these overall IT clusters. The definition of IT workers was developed by the *Computer Research Association* in 1999 and has since been used by many other organizations like the *Information Technology Association of America.*[14]

CONSTRUCTION INDUSTRY:

Within the construction industry, conversations surrounding the driving forces of technology were limited. Employers reminded us that construction is and will continue to be a "physically intense and labor-oriented industry". They referred only to general office/business functions like electronic billing systems and the surge of computer-based training for workers as the primary technology applications used. Construction representatives described the use of CD-ROMS, interactive web-sites, and other tools offering computer-based simulation for employee training as critical to their industry. In fact, they described keeping pace with computer-based training applications as their greatest IT struggle.

When provided the framework of IT related work, employers indicated that all IT hiring is done by corporate offices. They described primary need for IT workers in the areas of **Computer Systems Support, Maintenance and Repair and in Digital Media Technology, primarily Web Designers.** ***However, most stated that these were also targets for outsourcing and little hiring would take place within local offices.*** In addition, employers felt that corporate offices were more likely to grow their own IT workers (i.e., recruit, train, and promote from within) than recruit from the outside. While not representative of corporate offices, these employers felt no future shortages of IT workers would exist for their industry.

MANUFACTURERS:

Manufacturers described a wide array of factors contributing to the use of technology. Competition, or more directly the fear of falling behind competitors use of technology, consumed the conversations and was the base from which IT struggles were described. Many described the difficulty of making key business decisions around technology. Employers feared not having the latest hardware/software would negatively impact their ability to attract IT workers who are perceived as demanding state-of-the-art equipment and applications. Some companies also described how fear of competition drove them to invest heavily in system overhauls when ultimately they learned that former systems had served the company well. E-commerce was also described as a driving force of technology but as one employer stated, "how many company's would invest in E-commerce if competitors were not?". Jumping on the E-commerce "band wagon" was described as yet another IT struggle.

In addition to competition and E-commerce, new ERP systems, need to expand network systems and the Intranet, inventory control, access to faster/more accurate data, ability to do business with vendors/customers using compatible technology or Electronic Data Interchange (EDI) applications, and increases in end-users of technology were all described as driving forces of technology. Lack of business understanding among "technically oriented workers" and difficulty keeping pace with incumbent worker training on how to use new computer systems were described as the greatest IT challenges.

Manufacturers described a current and future need for IT workers in nearly every dimension of IT related work. **Computer Systems Support personnel and Networking Specialists** were mentioned most often. A couple of employers currently had vacancies for Network specialists. Manufacturers did not necessarily view Digital Media Specialists as IT workers but indicated that related technology skills would be required of marketing personnel. Group participants also indicated that the demand for computer programmers was not as great as it was in the early 1990's and many were hiring **programmers as temporary workers** to satisfy company needs. In fact, manufacturers described a great deal of out-sourcing for IT related work. They indicated that those workers hired and kept in-house were more likely to be IT "generalists" who could help maintain computer systems, work within network environments, and integrate computer based systems with business applications. Some manufacturers said they would also retain information support personnel or "help desk" staff. In addition, the manufacturers described a dramatic need for senior managers to understand the nature of technology, when and why technology should be used, and how it relates to overall business competitiveness and productivity. **Database development and management** was also described as an area of need and manufacturers predicted that **Web Security** would be an area of demand given the growth in E-commerce activity.

Manufacturers are willing to offer many incentives to attract and retain IT workers. While tuition reimbursement, retirement plans, and casual wear were described as primary incentives offered to IT workers, most of the dialogue centered around flexible work hours and tele-commuting options for IT workers. One manufacturer said, " I was going to lose two database administrators because of work hours and had to fight to change their start time from 7:30 am to 8:30." Another employer was allowing their IT workers to work from home two days a week.

Employers believe there will be future shortages of IT workers within the manufacturing industry. They attribute these shortages not solely to an inadequate supply of workers, but suggested that software companies will continue to lure IT workers from manufacturers and that burnout is common in the IT field impacting turnover. All agree that technology applications will increase but they also reiterated the option of contracted IT work and most did not have plans of expanding their in-house IT workforce. Like the construction industry, manufacturers indicated that the greatest hiring demand would come from corporate offices.

[14] CRA. 1999.

TRUCKING/WAREHOUSING:

According to group participants, "there are certain types of companies within the trucking industry, such as distribution, that are more sensitive to the use of technology and technology change". At the same time, "over the road hauling" companies were able to describe a range of technology applications for their companies. This included computerization of engines, inventory, customer ordering, and the use of laptops by drivers for logging time in and out as well as maintenance scheduling. Competition, better customer service, improved efficiency, and worker safety were mentioned as driving forces of technological change. Keeping pace with technology, balancing automation with costs, technology implementation taking longer than anticipated, and keeping computer-based systems functioning were described as the greatest IT struggles. These employers also mentioned that finding drivers was a greater struggle than finding IT workers.

The need for skilled technology workers is anticipated in a variety of venues. Diesel mechanics will need to become computerized technicians. Workers will also need skills in computerized routing to enhance overall efficiency. Employers indicated that **Networking Specialists, Web-design personnel, and Computer Services Support, primarily Help-Desk personnel** are the areas in which trucking/warehousing industry anticipate hiring needs over the next couple of years. *Participants agreed, however, that most of these IT services are currently out-sourced and for those companies that did not contract for services, IT work is performed by corporate offices and directed to the local level.* In fact, after reviewing the definition of IT workers and framework of IT-related work, most companies did not feel they currently employed any IT workers. The company which did have an IT worker on staff described a high level of turn over and their inability to match competitive salaries to retain workers. Like manufacturers, trucking/warehousing employers believe that increased demand for IT workers coupled with burnout are likely to drive future shortages. Opinions were, however, mixed as some believed that there would be no future shortages given the computer skills of emergent workers. Many felt youth/young adults entering the workforce would be able to adequately satisfy technology related needs into the future. Both flexible work hours and work from home were described as probable incentives for finding and attracting IT workers.

PUBLIC UTILITIES/COMMUNICATION INDUSTRY:

Global competition and deregulation were described as the primary forces driving technological change among the public utilities and communications industry. Employers also mentioned a variety of technological applications currently in place including automated accounting, purchasing, inventory control, tracking systems (ex: power outages), and meter reading. Many companies discussed expansion of mainframe systems to accommodate growth in Intranet networking applications to promote internal communication (ex: Email). Technology is being utilized in many ways to facilitate product delivery and some mentioned that nearly half of the sales force work from home which predicates the need for technology in numerous ways.

Like other industries, training incumbent workers on computer use and modern technology was described as one of the greatest IT struggles. Interestingly, these employers also talked about the challenges associated with balancing industry standardization of automated systems with customized systems to better serve the individual company.

Envisioning where there companies would be technologically in just a couple of years, most employers discussed how all workers in the industry would need to interact with technology. These employers constructed an ideal scenario whereby an automated order and customer service delivery system would become reality for all firms. A sales person would take an order, enter it into a network system and office personnel would shoot the order directly into the field for overall efficiency and productivity. In doing so, field personnel could minimize time spent traveling back and forth to the office.

This industry currently employs a host of IT workers including Computer Services Support personnel, Networking Specialists, and Systems Integration personnel. In fact, some are having a difficult time finding qualified AS400 programmers at the current time. These employers expect a hiring demand in all areas of IT specialty: **Computer Services Support, Digital Media Specialists, Network Specialists, Systems or Product Development/Integration,** and **Technology Executives.** Geographic Information Services (GIS) personnel and E-commerce specialists were also mentioned as a specific areas of probable need. In prioritizing future need for IT workers, some felt the greatest demand would be in Systems or Product Development/Integration.

Out-sourcing of IT work varied by company. Most currently employ computer service and networking personnel in-house while systems integration work is out-sourced. However, some also indicated a desire to out-source support service functions. Most agreed that small-medium sized companies do not employ as many IT workers as larger firms. They anticipate, however, that all public utility and communication firms will need to employ their own IT workers in the near future. These employers did not talk specifically about a future shortage of IT personnel but rather the need for all workers to be technology literate. They also assumed that young workers would have greater technological abilities thereby offsetting future IT shortages to some degree.

In terms of recruitment, these companies are still more concerned with finding certified operators and customer service personnel than IT workers. Like other industries, flexible work hours and tele-commuting are becoming more common and are likely to be an attraction tool for IT workers. Employers perceive that younger workers will demand flexibility.

RETAILERS

Retailers described a host of technology related applications impacting their work. This included automated business systems (accounting, sales tracking, etc.), networking applications which allow local offices to communicate with central offices, and E-commerce activity allowing people to shop on-line. One of the greatest IT struggles described

was patching mainframe systems from the early 1980's with new systems and the desperate need for programmers who have the ability to integrate new systems with old.

Hiring is anticipated in many IT areas of specialty including **Networking Technology, primarily LAN/WAN managers, Systems/Product Development and Integration, and Digital Media Technology.** At the current time, retailers are more concerned with finding retail sales workers/customer service representatives and talked little about the recruitment and retention of IT workers. Again, there is a sense that the larger retailers with corporate offices like Lazarus, will have the greatest need for IT workers. In most cases, IT work is generated at this level for the local stores. There was also conversation that IT shortages were driven primarily by Y2K and that demand is leveling off.

BANKING & FINANCE

Competition and customer service delivery are the primary forces driving technology within the banking/finance industry. Local area and wide area networking applications consumed the dialogue among banking/finance employers. They discussed their wide area networks as linking to international banking facilities. **Computer Services Support, Maintenance, Repair personnel and Networking Specialists are in greatest demand across all sizes of establishments and projected to be in demand into the future.** In fact, some employers discussed their inability to find good support, repair specialists. LAN/WAN managers are described as the primary Network specialists in greatest demand. In addition, these employers envision a great need for **Digital Media Specialists** as E-commerce activity increases and people use the Internet for personal banking. Participants also discussed the need for people who can use enormous amounts of data and information for actual decision making, not just to generate the data. **Systems/Product Development and Integration are anticipated areas of demand for corporate offices.**

Interestingly, many of these employers have not experienced unacceptable levels of turnover among IT workers and most currently employ anywhere from four to ten IT workers. Finding and retaining bank tellers and other personnel are more of a problem for banking/finance companies. Flexibility with work hours including comp time are likely incentives for IT workers. If a shortage is to occur, participants envision it will be in the area of Digital Media Technology given the labor needed to support E-commerce and other Web activity.

HEALTH SERVICES:

Health care providers believe technology is eminent as establishments will invest in the "greatest and latest technology for patient care regardless of the cost". They indicated that applications are moving into the critical care area daily. Other than patient care, a variety of technological applications were described by these service providers including computerized medical records (important for insurance, lawyers, Medicaid, etc.), patient charting, human resource functions, and government mandated reporting systems. Nearly all of the discussions were, however, consumed by networking applications.

Employers describe their greatest IT struggles around integration of systems within establishments, across multiple campuses, and integration with other hospitals and providers of service. In addition, incumbent worker training for administrative, managerial, nursing, clerical and other staff was described as an "insurmountable task".

The greatest demand for IT workers are in areas of **Computer Support, Maintenance, and Repair, and Networking Technology. Network technicians and LAN/WAN managers are great demand.** This trend is expected to continue as hospitals merge and satellite centers are created in suburban and rural areas. **Web development** is yet another area health care providers expect an increase in demand. Like other industry sectors, many employers are out-sourcing help desk and networking functions to consultants or independent contractors. Health care providers also envision a need for **Database personnel** as data development, retrieval, and reporting will continue in relation to managed care and other environmental factors.

Health care providers have experienced dramatic problems with retention of IT workers. They attribute turnover to lack of obligation given bigger and better job prospects among younger IT workers, and also blame their own industry for creating lack of security and "loyalty" through continuous downsizing. Some employers indicated that they are losing IT workers, not just to other employers but to other states as well.

For key positions, like information management, providers are willing to offer what ever is necessary to fill vacant positions including comprehensive benefits packages, relocation fees, and tuition reimbursement for continued education.

ARCHITECTURE & ENGINEERING FIRMS:

Within architectural and engineering industries, electronic drawings have been a reality for quite some time. Still, these employers are struggling with a multitude of system integration issues, a host of software applications which are necessary to satisfy customer demands, and a surge in internal communication systems. One of the large employers said their president has a goal of communicating with 16,500 workers world wide within 15 minutes. In addition, employers discussed the overwhelming need for team-oriented project work and the necessity of sharing electronic documents and drawings.

The greatest IT struggle for architectural and engineering firms has been the recruitment of both IT workers and architects/engineers who both understand business applications and are also technologically competent. They claim it is extremely difficult to find both industry experience and IT expertise in one person. In addition, employers use multiple software applications (Auto CAD, ENAGRAPH, PROE, APPLICON and others) which creates significant incumbent worker training issues. Many are making investments in employee cross-training and job mentoring programs. The group praised the two year system of colleges for producing CAD Operators, which they say cannot be found from any other source. While worker recruitment is a struggle, employers are optimistic that in time the emergent workforce will help

to fill the gaps as children are introduced to technology at earlier ages.

Some of the large firms currently have IT departments but the ratio to other staff is as high as 1:70. Others do not have IS departments but employ a few IT workers. These employers say that IT staff like Computer Operations Directors/Managers are bred from existing professional staff rather than recruited from outside sources. **Network Specialists and Digital Media Technology personnel are in greatest demand within this industry.**

Architectural and engineering employers believe IT labor shortages are cyclical. According to them, Y2K created a demand for IT workers and shortly thereafter an abundance. They believe IT workers are now being absorbed for Internet functions and applications. Right now demand outweighs supply but employers anticipate that this too will change. They reiterated the need for computer intellects to have depth of understanding with industry specific business applications.

GOVERNMENT & EDUCATIONAL SERVICES:

Competition and information sharing were described as the primary forces driving IT among government and education providers. The group also made reference to an "information explosion" making it impossible to do without technology. Educators discussed many ways in which technology is impacting their organizations. Primarily was the changing nature of the teaching and learning environment which often takes place outside the walls of an institution. Universities and colleges are looking at ways to put course syllabus on web sites and to offer Email and chat rooms to students for overall improvement in quality of instruction and efficiency in service delivery. Distance learning applications were also mentioned. Participants also discussed how most areas of IT training can quickly become obsolete. They said, "just five years ago DOS and WordPerfect took 12 hours of training, now we do it in an hour and people feel comfortable." Educators anticipate that soon the PC era and programs in areas like PC Repair will be obsolete as the public begins to access the Internet through televisions and other means. Like other industries, education/training providers anticipate that continuous modification in programs will be necessary as the emergent workforce will require even less skill development in basic computer use. On the other hand, they recognize that technology investments will continue to mandate significant resources, not just for hardware and software, but for training of workers on ever changing applications. Instruction on self-learning techniques were considered key to all education and training programs.

Government officials, primarily economic development personnel, anticipate a surge in business networks to accommodate not use of technology but how to apply it to particular industry sectors. Others engaged in economic development feel we may be educating people for jobs that don't exist or for opportunities that can only be found in urban areas or outside the state of Ohio.

When asked about the areas of IT-related work they believe establishments, both small and large within these sectors will need to hire IT workers over the next couple of years, **Digital Media personnel, Networking Specialists, and Data Management/Warehousing were mentioned.** Digital Media Technology, primarily Web Developers and Web Enablers were referenced in relation to the state One-Stop efforts whereby individuals can access training and related services via the Internet. Networking applications were discussed in the context of Intranets, telecommunications, Email, and the explosion of information sharing. Database development and management were considered essential areas of demand as all sectors continue to generate more and more information.

Recruitment of IT workers is a serious concern for government and educational institutions as these organizations cannot offer competitive salaries. Some of the rural areas are also concerned that they will never be able to compete with the urban areas of the state for IT professionals and turn over will continue. Rural governments are offering some work-based learning opportunities in the form of internships and co-ops as a way of attracting IT learners into their organizations. Like the private sector, these employers also discussed the difficulty of finding technical workers who also have the ability to interact with people and a sense for how specific organizations operate.

Educators envision that customized training for individual sectors will be critical for making the connection between IT and business applications.

A shortage of E-commerce workers is anticipated into the near future but these employers feel labor demands will recycle every three or so years when new demands surface. Group participants were cautious of short term demand.

NOT-FOR-PROFIT ORGANIZATIONS:

While non-profit organizations are into the information age and making significant investments in technology purchases and upgrades, they describe a range of struggles associated with technology. Like the private sector, training individuals to administer new systems is described as a "grand hurdle" as many workers lack even basic computer skills. Keeping pace and staying compatible with the private sector was described as yet another struggle as was financing new equipment and applications. System interface, for example Windows NT systems with other OS2 systems, continue to be a challenge. Some organizations are also being mandated to use customized tracking and reporting software but lack the funds, time, staff, and expertise to link with national affiliates or federal/state government.

Greatest demand for IT workers is likely to be **Network Specialists and Digital Media Technology** personnel as non-profits develop communication systems and web-sites or things like on-line tutorials. While not currently hiring, non-profits discussed a probable need for **Database Development and Management** personnel as government accountability standards and reporting requirements continue. Like the public sector, non-profits express concern for IT worker recruitment and retention given the opportunities in the private sector. The non-profit sector anticipates that rapid changes in technology will drive

future shortages. They anticipate an era where IT specialty will no longer be the norm. The future IT worker was compared to a general practitioner in medicine and most non-profit providers believe workers should be prepared as IT generalists.

Employers also indicated that much IT work is contracted to consultants and/or independent contractors. They indicated that once a system or network is designed, more of the ongoing administration can be tackled in house.

DEMAND FOR INFORMATION TECHNOLOGY WORKERS:
OHIO COMPARED TO THE U.S.

❖ KEY FINDINGS ❖

Findings from the most recent national survey of employers (released in April 2000) are very comparable to the results of the focus group discussions conducted with Ohio employers:

Computer Support, Maintenance, & Repair is the number one area of demand nationally and hiring is likely in all types and sizes of firms.

Network Specialists will account for 20% of all new IT jobs nationally and are in demand by all types and sizes of firms.

Combined, Technical Support Specialists and Networking Specialists will represent 50% of all new jobs in the nation.

Web Specialists will account for 13% of all new IT jobs nationally.

Overall, Database Developers/Administrators are the 2nd hotest IT job nationally while Programmers/Software Developers rank 3rd, *but most hiring for these positions will occur primarily in IT companies and other large establishments.*

Firms employing 50-99 workers are expected to constitute 70% of all new IT jobs.

The secondary analysis of data coupled with the focus group discussions conducted on behalf of The EnterpriseOhio Network provide some basis for comparing demand for IT workers in Ohio with that of the entire U.S. Most of the national studies conducted in recent years are private surveys or are conducted by IT professional associations. *ComputerWorld Inc.*, for example, conducts quarterly surveys of IT managers as well as annual salary surveys. Many of the findings mirror those of the state analysis. For instance, the *ComputerWorld IT Jobs Forecast of 1999* ranked Network Administrators as the number one job in greatest demand for the East North Central portion of the U.S. including Ohio, West Virginia, Indiana, Illinois, and Michigan. LAN Managers were also among the top five hotest jobs in this region and Technical Support Managers ranked tenth. Webmaster/Web Designers were also among the top ten jobs IT managers described as in greatest demand by employers

In the same survey, PC Technical Support Specialists ranked among the top five hotest jobs in this region and Technical Support Managers ranked tenth. Webmaster/Web Designers were also among the top ten jobs IT managers described as in greatest demand by employers.[15]

IT JOBS FORECAST according to ComputerWorld Survey of IT Managers in 1999

Rankings of jobs that IT managers indicated will be in most demand for the East NorthCentral portion of the U.S. (Ohio, West Virginia, Indiana, Illinois, & Michigan):

Network Administrators
Senior Systems Analysts
Project Managers
PC Technical Support Specialists
Senior Programmer/Analysts
Programmer/Analysts
Webmaster/Web Designers
LAN Managers
Computer Operators
Technical Support Managers

Rankings of jobs that IT managers indicated they will need most CONTRACT help in:

Project Managers
Senior Programmer/Analysts
Network Administrators
Webmaster/Web Developers
Programmer/Analysts

The most recent professional association survey was released in April, 2000 by the *Information Technology Association of American (ITAA).*[16] Some of the important findings of this study are identical to the state analysis:

- Computer Support, Maintenance, & Repair is the number one area of demand nationally and will account for over 600,000 new jobs or one-third of all IT openings. Hiring is likely in all types and sizes of firms.
- Network Specialists will account for 20% of all new IT jobs nationally and are in demand by both IT firms and non-IT firms including small medium sized establishments.

[15] ComputerWorld Inc., IT Jobs Forecast of 1999.

[16] *"Bridging the Gap: IT Skills for a New Millennium"*, ITAA, 2000.

- Combined, Technical Support Specialists and Networking Specialists will represent 50% of all new jobs in the nation.
- Web Specialists will account for 13% of all new IT jobs nationally.
- Overall, Database Developers/Administrators are the 2nd hotest IT job nationally, *but most hiring will occur in IT companies and other large establishments only, not among small and medium sized firms.*
- Overall, Programmers & Software Developers ranked 3rd in demand for IT positions nationally, but like Database Developers/Administrators most hiring will occur within large establishments and among IT suppliers.
- Smaller, non-IT firms (employing 50-99 employees) will constitute 70% of all new IT jobs.

IT skill requirements, importance of vendor/industry certification for IT workers, and skill acquisition data resulting from the ITAA survey also mirrored the analysis conducted for the state of Ohio. This information is presented in the next chapter of this report.

Lending further support to the overwhelming demand for Computer Support Specialists, the greatest number of jobs are projected for these positions of all existing technician occupations.[17]

Technician Occupation	2008 Jobs	98-08 Number	98-08 %
Tech & Related Support Occ	6,048	1,098	22.2%
Health Technicians & Technologists	3,063	616	25.2
Cardiovascular Technicians & Technologists	29	8	39.4
Clinical Lab Technicians & Technologists	366	53	17.0
Dental Hygienists	201	58	40.5
EKG Technicians	10	-3	-23.1
Electroneurodiagnostic Tech.	6	0	5.9
EMT's & Paramedics	197	47	31.6
Lic. Prac & Lic Voc Nurses	828	136	197
Med Rec & Health Info Tech	133	41	43.9
Nuclear Med Technologists	16	2	11.6
Opticians, Dispensing	81	10	13.8
Pharmacy Technicians	126	17	15.7
Psychiatric Technicians	73	7	15.7
Radiologic Technicians & Technologists	194	32	20.1
Surgical Technologists	77	23	41.8
Veterinary Technologists & Technicians	37	5	16.2
All Other Health Prof & Para	688	178	35.0
Engineering & Science Technicians & Technologists	1,525	175	12.9
Engineering Technicians	897	126	16.3
Electrical & Electronic Technicians & Technologists	391	56	16.8
All Other Engineering	506	70	15.9
Drafters	301	18	6.4
Science & Math Technicians	243	16	7.0
Surveying & Mapping Tech	84	15	21.8
Technicians, Except Health & Eng & Science	1,460	308	26.7
Aircraft Pilots & Flight Eng	99	6	5.9
Air Traffic Controllers	30	2	6.0
Broadcast & Sound Tech	39	2	6.0
Computer Programmers	839	191	29.5
Legal Asst & Tech	346	94	37.4
Paralegals & Legal Asst	220	84	62.0
Title Examiners, Abstractors, Searchers	29	0	-0.6
All Other Legal Asst, Inc Law Clerks	96	10	11.6
Library Technicians	85	13	18.2
All Other Technicians	21	1	4.1

While most state level data shows that out-sourcing of IT work is likely to continue, some national surveys are projecting that firms "plan to expand their permanent staffs in place of so much reliance on contractors and consultants". The most recent *ComputerWorld* survey of IT managers also reveals that most hiring will occur in Internet and other application development, followed by Networking, E-commerce, and data mining specialists. [18]

[17] Technical Education Resource Monitor (TERM), February 2000.

[18] ComputerWorld, 1/3/00.

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DEMAND FOR INFORMATION TECHONOLOGY WORKERS:
SUMMARY BY PRIMARY CLASSIFICATION

PRIMARY IT CLASSIFICATION	DEFINITION OF WORK	GOVERNMENT PROJECTIONS & LABOR CERTIFICATES	JOB VACANCY DATA IN OHIO	FOCUS GROUP DISCUSSIONS WITH OHIO EMPLOYERS	NATIONAL COMPARISON
COMPUTER SUPPORT, MAINTENANCE, REPAIR **Related Jobs:** Computer Operations Manager & Supervisors, Computer Operations Technician, Technician Specialists, Technical Support Engineers, Help Desk Technicians, PC Technicians, Support Specialists, Customer Service Reps.	Provides customer and technical support through analysis and problem solving to facilitate installation, maintenance, education, and documentation of a variety of technologies. (Northwest Center for Emerging Technologies, Bellevue Community College, Washington).	4th largest number of jobs in 1996 and 4th largest growth rate to 2006 (73.3%) in Ohio. (OBES).	5TH largest job currently and projected for IT suppliers in NE Ohio. Even more important to non-IT large establishments in NE Ohio (3rd in demand). (Cleveland Growth Assoc, 1999). Highest number new jobs in greater Columbus (15 companies alone will add 22 jobs in 3 years). (Columbus Chamber of Commerce unpublished data, 1999).	Demand evident across all industry sectors and sizes of firms across Ohio. Some work will be outsourced. **Service Delivery Opportunity:** Employers wondered if EO Network could offer Call Center/Help Desk Services to employers/workers.	#1 demand nationally @ 1/3 of all new IT jobs (over 600,00). Hiring likely among all types and sizes of firms. (ITAA, 2000). #1 in new jobs among 36 technician/technologist occupations in U.S. (Computerworld, 1/3/00). #4 job in most demand for EN Central U.S. behind networking admins; senior analysts; and program managers. (Computerworld, 1999.).
NETWORK SPECIALISTS **Related Jobs:** Manager, Voice & Data Communications, LAN/WAN Managers, Intranet Managers, Communications Specialists & Analysts, Network Specialists, Network Technicians, Network Security Managers & Specialists.	Analyzes, operates, administers, maintains, tests, and implements the network interconnections of devices, systems, and/or communication services to meet functional objectives of the business. (Northwest Center for Emerging Technologies, Bellevue Community College, Washington).	Data Communications Analysts clustered with "all other computer scientists" but showed 2nd largest # jobs in 1996 and highest growth rate of all IT jobs to 2006 (171.3%). (OBES). 1% of Ohio's permanent IT labor certificates; same as U.S. (Dept. Of Labor, 1998).	2nd largest job currently and projected for IT Supplies and large establishments in NE Ohio (Cleveland Growth Assoc., 1999). Projected increase in jobs & considered "most important" to business operations of all IT work. (Columbus Chamber of Commerce unpublished data, 1999).	Demand evident across all industry sectors and sizes of establishments in Ohio. LAN/WAN Managers and Network Technicians mentioned most frequently. Some work will be contracted out to consultants, independent contractors.	Near 20% of all new jobs nationally and in demand by both IT and non IT companies including small firms (50-99 employees) which will constitute 70% of all new IT jobs. (ITAA, 2000). Network Adminitrators #1job in most demand for EN Central U.S. (Computerworld, 1999.). Computer Security and Network Designers among top 10 jobs in greatest demand. (CRA, 1999).

DIGITAL MEDIA TECHNOLOGY **Related Jobs:** Creative Director, Webmaster, User Interface Designers, Animator, Imaging, Audio Visual Specialists, Interactive Digital Media Specialists, Multi-Media Programmers & Technicians, Graphic Designers, Content Development Specialists, On-line/Script Writers, Artists 2D/3D, Multi-Media Authoring Specialists, Production Assistants.	Creates, designs, develops, and produces digital media products, which integrates any combination of audio, video, graphics, text, and animation. (Northwest Center for Emerging Technologies, Bellevue Community College, Washington).	Not part of government occupational classifications.	Not Available	Demand across all industry sectors. Webmasters & Web Designers referenced most frequently. Internet Security mentioned as an emerging area of demand by Banking/Finance Industry. Many sectors (Construction, Trucking/Warehousing, Utilities & Communications, Banking/Finance, & Architecture & Engineering) will continue to contract Web Design to consultants, independent contractors.	Near 13% of all new IT jobs nationally. (ITAA, 2000). Webmasters & Web Designers: 7th highest demand among IT managers & #1 occupational cluster employers willing to pay higher salaries (Computerworld, 1999). Among 5 areas IT managers will need most *contract* help. (Computerworld, 1999). Web & E-commerce Specialists among top 10 IT jobs (CRA, 1999).
SYSTEMS DEVELOPMENT & INTEGRATION: **DATABASE DEVELOPMENT, WAREHOUSING** **Related Jobs:** Database Managers, Database Developers, Database Modelers, Database Analysts, Repository Architects, Database Administration Associates.	Database administrators participate in conceptual, logical data modeling and physical design, database implementation, maintenance, and support.	Lowest number of jobs for all IT occupations in 1996 but growth rate of 72.9% expected to 2006 in Ohio. (OBES). 1% Ohio's IT permanent labor certificates which is same for U.S. (Department of Labor, 1998).	DB Management critical to IT suppliers and large employers BUT not as high demand as programmers/analysts, networking, or technical support representatives in NE Ohio (Cleveland Growth Assoc., 1999).	Database development, retrieval, and reporting discussed relative to increased government accountability, managed care, and need to apply increasing amounts of data/information generated to business decisions, but actual hiring for these positions not mentioned.	"Data modeling and warehousing got a lot of attention in early days of relational databases, but many companies never followed through on projects . . .Need for resource management is coming back. Understanding how data is managed and used across companies is important". (Computerworld, 1999). Database Developers/Adminstrators described by employers as 2nd hotest IT job nationally, ***BUT, most hiring is with IT firms and large employers***, not small/medium sized as of yet.

SYSTEMS DEVELOPMENT & INTEGRATION: **PROGRAMMERS & SYSTEM ANALYSTS** **Related Jobs:** Program & Project Managers, Senior Systems Analysts, Systems Analysts, Senior Systems Programmers, Requirements Engineers, Senior Programmer/Analysts, Programmer/Analysts, System Architects, E-Commerce Managers & Specialists, Security Managers & Specialists, Applications & Test Engineers/Analysts.	Analyzes, designs, develops, tests, implements, and maintains computer applications systems to meet functional objectives of the business. (Northwest Center for Emerging Technologies, Bellevue Community College, Washington).	Programmers had the greatest number of jobs in 1996 but *fewest new jobs and lowest growth rate* are expected to 2006 for both the U.S. (22.8%) and Ohio (19.3%). Systems Analysts expected to have the greatest number new jobs to 2006 and the 3rd largest growth rate to 2006 (U.S. 102.8% and Ohio 93.6%). (BLS & OBES) Programmers 1%, Programmer/Analysts 11%, Systems Analysts 5%, & Systems Hardware Analysts 1% of Ohio's IT permanent labor certificates, all of which were higher than the U.S. (Department of Labor, 1998).	Programmers/Analysts ranked number one in current and projected jobs for IT suppliers and IT-enabled large employers in NE Ohio (Cleveland Growth Assoc., 1999). 2nd most common area of business activity in Greater Dayton (Dayton Chamber of Commerce, 1999).	Greatest demand for programmers and system analysts is among large employers and corporate offices. Hiring is not expected among small and medium sized companies in Ohio. If needed, most employers will out source these IT functions.	Programmers & Software Developers combined are 3rd in overall IT demand nationally, but mainly in IT companies and large firms. (ITAA, 2000). While not highest in demand among smaller and medium establishments, is two areas with greatest skills gap nationally (ITAA, 2000). IT managers say Systems Analysts are in greater demand than programmers & Senior Systems Analysts ranked 2nd in demand among IT managers for the NE Central U.S. (Computerworld, 1999).
SYSTEMS DEVELOPMENT & INTEGRATION: **SOFTWARE ENGINEERING** **Related Jobs:** Software Design Engineers, Software Engineers, Software Developers, Software Quality Assurance Analysts, Software Test Developers, Functional Testers, Test Engineers, Software Applications Engineers.	Applies general engineering principles and methodologies to software development. (Northwest Center for Emerging Technologies, Bellevue Community College, Washington).	Computer Engineers show the highest growth rate to 2006 for U.S. (109.1%) and Ohio (102.7%) excluding the "all other" classification. (BLS, OBES). Software engineers constituted the largest share of Ohio's IT permanent labor certificates (21%). The U.S. share was at 16%. (Department of Labor, 1998).	Software Engineers 3rd largest number current and projected jobs for IT Suppliers, but 5th for IT-enabled large employers in NE Ohio (Cleveland Growth Assoc., 1999).	No hiring demands discussed. Most relevant to IT firms and large Ohio manufacturers.	Software Developers and Programmers combined are 3rd in overall IT demand nationally, but mainly IT companies and large firms.(ITAA, 2000) Not among high demand for smaller, non-IT firms (50-99 employees) which will constitute 70% of all new IT jobs(ITAA, 2000). Software Engineers were not among the jobs in greatest demand according to IT Managers and Salary Surveys (Computerworld, 1999).
EMERGING:	PROJECT MANAGERS/LEADERS;	TECHNICAL WRITERS;	SECURITY SPECIALISTS		

IT WAGES & SALARIES: OHIO COMPARED TO THE U.S.

❖ KEY FINDINGS ❖

Nearly all sources indicate that IT wages/salaries in Ohio are lower than other areas of the U.S.

THIS COULD MEAN:
Ohio employers are not as desperate for IT workers and a severe shortage or more fundamental shift in the economy has not yet occurred.

OR:

If an IT shortage is assumed for Ohio, it is likely to be longer lasting than other areas of the U.S. as our state struggles to attract new workers and retain the workers it does produce.

AND YET:
If employers were to raise salaries and education/training providers were to produce more IT workers, at some point the state might find itself in an excess supply stage (i.e., with more IT specialists than IT jobs).

Lower wages and the loss of IT talent to other states should be a matter of concern for Ohio. Increases in supply of IT workers by the EnterpriseOhio Network and other education/training providers will not help to alleviate shortages if Ohio is unable to retain the workers it produces.

In addition to government projections, permanent labor certificates, job vacancies, and the existence of public-private partnerships to enhance the supply of IT workers, it is important to consider the extent of labor shortages in a yet another context. The U.S. Department of Labor defines a labor shortage as "a market disequilibrium between supply and demand."[19] Most economists caution, however, that there are two components to the "market disequilibrium" that are *required* for a shortage to occur:

> The first element is that the quantity demanded of workers of a particular type exceeds the quantity supplied at the going market wage. The second element is that the market must adjust slowly or not at all to the imbalance.[20]

This means in a shortage situation employers need more workers than actually exist or education/training providers can supply, *AND the market is slow to increase wages/salaries or offer other incentives to attract individuals into areas of high demand.* Typically, shortages are short-term in nature because the market can, and frequently does, satisfy it's own needs. Dr. Lerman suggests:

> [We] should be cautious about efforts to expand the supply of [IT] workers given the boom and bust cycles often observed in these fields . . . By the time [we] act to increase supply, the market may have already shifted from an excess in demand to an excess supply stage.[21]

While different factors can impact the time frame within which a market adjusts to "imbalances" between supply and demand, (like the length of training required to produce more workers), the duration of worker shortages is dependent on the ability of business/industry to attract and retain workers through competitive salaries. Higher wages and salaries are indicative of a market that is trying to adjust to significant worker shortages. If there is a real shortage of workers in Ohio, then we would expect to see increasing wages/salaries as a means for attracting workers into a field where the labor pool is inadequate to satisfy demand.

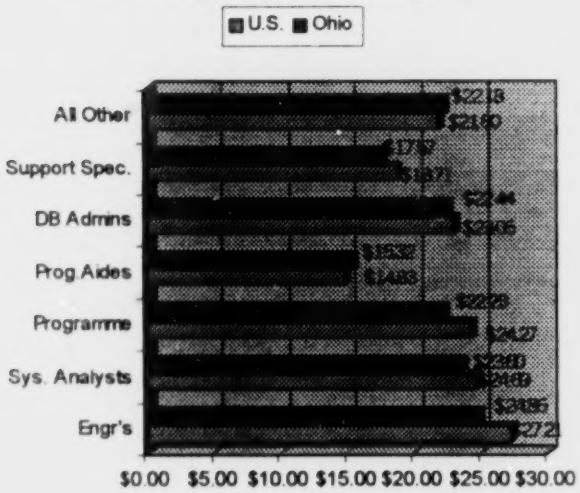
But, according to government sources, the average wages/salaries for IT workers in Ohio are lower than national averages. This is true for all IT occupations except Computer Programmer Aides which tend to make .49 an hour more in Ohio. The greatest discrepancy in pay is noticeable for Computer Engineers who on average, make $2..35 less an hour in Ohio. Ohio's Computer Programmers also make $2.04 less an hour than do Programmers across the nation. Computer Support Specialists and System Analysts in our state make $1.14 and $1.09 less per hour respectively, while Database Administrators make .62 less per hour.

[19] U. S. Department of Labor.

[20] Lerman, The Urban Institute, 1998.

[21] Lerman, The Urban Institute, 1998.

1997 Average Wages for IT Occupations



Sources: Occupational Employment Statistics Survey, 1997 & Ohio Bureau of Employment Services, Labor Market Division

While no wage and salary surveys were uncovered in Ohio, some national research by industry professionals have compared portions of our state to other regions throughout the U.S. This too is frequently an area where study results are often conflicting. While private studies often show dramatic increases in IT salaries, other employer-collected data has revealed that salaries are not much higher than other professional specialty occupations or that the increases are short-term and typically "flatten out" over time. This means private studies may over-emphasize wage/salary increments for IT workers, but the implications are still important for determining the probable duration of labor shortages for Ohio.

As indicated, government sources indicate that average wages/salaries for IT workers in Ohio are lower than national averages. Most private studies show similar results. Both the Columbus and Dayton metropolitan regions of Ohio were included in a comparison study of "hourly compensation paid to Computer Scientists/Analysts (a profession thought to be in shortage) and Secondary School Teachers (a profession whose workers are often said to be underpaid)."[22] Data was collected through the National Compensation Survey (NCS) with "careful classification by BLS field economists of workers into selected occupations."[23] Overall, the study found "the mean rates of hourly compensation reported by employers for Computer Scientists and Analysts in selected metropolitan areas were well above the wages paid to white collar workers but were generally below the wages paid to Secondary School Teachers. While this was not the case for Ohio regions, both areas had among the lowest reported salaries for Computer Scientists/Analysts. The Dayton-Springfield region ranked 10th and the Columbus region ranked 13th among the 14 comparison regions.

In addition, IT salaries in Cleveland were compared to 19 other cities across the nation in a survey conducted by *ComputerWorld Inc.* in 1999. This study focused on 12 different classifications of IT workers. Wages and salaries for each job classification were also analyzed by number of years of experience. Generally, Cleveland ranked higher (usually around the midpoint) in salaries for IT workers with 1-2 years experience. Lower rankings in salaries were reported, however, for IT workers with 3-4 years, or 4 or more years experience.

Salaries in Cleveland were highest for the following job classifications:

- Chief Information Officers with 4 or more years experience (2nd highest)
- Network Administrators with 1-2 years experience (3rd highest)
- Programmer/Analysts with 1-2 years experience (6th highest)
- Chief Information Officers with 1-2 years experience (7th highest)
- Computer Operations Manager with 1-2 years experience (7th highest)

Salaries in Cleveland ranked among the lowest for the following IT jobs:

- LAN Managers with 4 or more years experience (19th)
- Senior Systems Programmer with 4 or more years experience (18th)
- Network Administrators/Analysts with 4 or more years experience (16th)
- LAN Managers with 3-4 years experience (15th)
- Network Administrators/Analysts with 3-4 years experience (15th)
- Senior System Analysts with 4 or more years experience (15th)
- Senior Programmer/Analysts with 4 or more years experience (15th)
- Project Manager with 3-4 years experience (14th)
- Programmer/Analyst with 3-4 years experience (13th)

There are different ways to interpret the lower wages/salaries reported in Ohio. Because IT salaries are not as competitive we might assume Ohio employers are not as "desperate" for workers, or a severe shortage and more fundamental shift in the economy has not yet occurred. "If serious shortages were taking place, we would expect market pressures to raise salaries for IT workers more rapidly than for other professional workers."[24] On the other hand, if we assume there is a shortage of IT workers in Ohio, then lack of competitive salaries and our inability to retain IT talent could mean that the existing shortage will last longer than other areas of the U.S. And yet, if employers were to raise salaries and education/training providers were to produce more IT workers, at some point the state might find itself in an excess supply stage. In any event, potential loss of IT talent to other states should be a matter of concern for Ohio, particularly as the EnterpriseOhio Network and other

[22] National Compensation Survey (NCS) and Bureau of Labor Statistics, Tabulations by the Urban Institute, 1998.

[23] "Emerging Trends in the Information Technology Job Market: How Should the Public and Private Sectors Respond", Dr. Robert I. Lerman, The Urban Institute, Testimony before the Subcommittee on Oversight and Investigations on Education and the Workforce, United States House of Representatives, April 23, 1998.

[24] Lerman, The Urban Institute, 1998.

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education/training providers strive to increase the supply of workers. More workers will not help ease shortages if Ohio is unable to offer competitive IT salaries to retain the workers it does produce.

ComputerWorld Inc., Midyear Salary Survey

IT Job Title	Experience	Cleveland	Ranking 20 cities	High & Low
Chief info officer	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	130,000 147,000 198,300	7th 8th 2nd	Minn/St Paul = 175,700; Philad = 71,800 Minn/St Paul = 187,500; Denver = 82,700 San Fran = 200,300; Phoenix = 106,800
Director of IS/MIS	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	86,400 93,100 99,400	10th 12th 12th	San Fran = 115,200; Denver = 60,000 Dallas = 126,800; Denver = 67,900 NY = 132,500; Denver = 84,000
Computer Operations Mgr	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	65,600 71,500 77,700	7th 10th 11th	San Fran = 83,300; Atlanta = 49,300 San Fran = 92,600; Houston = 57,000 San Fran = 101,600; Atlanta = 69,500
Network Admin/Analyst	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	54,000 54,300 59,100	3rd 15th 16th	NY = 65,100; Atlanta = 35,700 Miami = 75,400; LA = 49,900 Miami = 84,100; Atlanta = 53,300
LAN Mgr	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	NA 54,300 57,500	-- 15th 19th	Miami = 65,200; Atlanta = 39,000 NY = 73,400; Denver = 49,700 Miami = 84,100; Denver = 55,000
Project Mgr	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	59,500 63,500 74,400	9th 14th 11th	NY = 70,100; Denver = 45,900 San Fran = 78,500; Denver = 51,300 San Fran = 89,100; Denver = 62,500
Senior Systems Analyst	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	56,400 60,100 65,600	10th 12th 15th	NY = 69,300; Houston = 43,900 NY = 75,000; Denver = 52,600 NY = 88,300; Phoenix = 61,200
Senior Systems Programmer	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	53,000 59,800 61,900	9th 11th 18th	NY = 68,400; Chicago = 43,200 NY = 77,700; Philad & Houston = 55,200 NY = 84,900; Philad = 60,800
Senior Programmer/Analyst	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	48,300 55,000 60,300	11th 11th 15th	NY = 63,100; St. Louis = 38,300 LA = 70,900; St Louis = 46,200 NY = 80,600; St Louis = 50,900
Programmer/Analyst	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	42,600 45,400 52,900	6th 13th 11th	NY = 50,400; St Louis = 27,400 NY = 57,400; St Louis = 31,800 NY = 69,700; St Louis = 35,800
Computer Operator	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	28,800 34,200 NA	8th 9th --	NY = 34,200; Houston = 25,500 NY = 40,700; Houston = 30,300 NY = 45,400; Houston = 31,400
PC Technical Support Specialist	Low (1-2 yrs) Mid (3-4 yrs) High (4+ yrs)	32,900 39,600 43,400	9th 8th 11th	Washington = 37,400; Houston = 27,400 NY = 45,200; Houston = 33,100 NY = 49,800; Philadelphia = 38,300

"No Cure in Sight: ComputerWorld Midyear Salary Survey Special Report", Business Special Report, Computerworld, March 29, 1999.

Hourly Compensation Comparison of Computer Scientists to Secondary School Teachers

Mo. Of Survey	Metropolitan Area	All White Collar Workers	Computer Scientists/Analysts	Secondary School Teachers	Wage Gap Teachers v. Computer Scientist	% Wage Gap Teachers v. Computer Scientist
Feb 97	Charlotte-Gastonia-Rock Hill NC	18.27	27.78	19.55	(8.23)	70.4%
Jan - 97	Columbus OH	16.97	23.10	27.68	4.58	119.8%
Dec - 96	Dallas-Fort Worth TX	18.69	26.11	22.54	(3.57)	86.3%
Apr - 97	Dayton-Springfield OH	16.81	24.72	26.55	1.83	107.4%
Dec - 96	Denver-Boulder - Greeley Co	18.79	28.90	24.08	(4.82)	83.3%
Jan 97	Detroit-Ann Arbor-Flint MI	20.40	27.53	36.18	8.65	131.4%
Mar 97	Hartford CT	22.21	25.66	36.29	10.63	141.4%
Jan 97	Minneapolis - St. Paul MN-WI	19.95	26.29	28.19	1.90	107.2%
Sep 96	New Orleans LA	15.80	26.68	20.32	(6.36)	76.2%
Feb 97	NY- Northern NJ - Long Island	23.10	33.08	41.45	8.37	125.3%
June/July 96	Rochester NY	17.26	21.39	36.07	14.68	168.6%
Mar 97	St Louis, MO-IL	17.65	23.91	26.98	3.07	112.8%
Aug/July 96	Salt Lake City UT	14.74	24.37	23.04	(1.33)	94.5%
Feb 97	Washington-Baltimore, DC - MD-VA-WV Unweighted Averages	19.33 18.57	25.68 26.09	28.45 28.38	2.77 1.89	110.8% 109.7%

"Emerging Trends in the Information Technology Job Market: How Should the Public and Private Sectors Respond", Dr. Robert I. Lerman, The Urban Institute, Testimony before the Subcommittee on Oversight and Investigations on Education and the Workforce, United States House of Representatives, April 23, 1998.

IT SKILL REQUIREMENTS

OHIO EMPLOYERS ON IT SKILL REQUIREMENTS

IMPORTANCE OF WORK-BASED LEARNING APPLICATIONS

IMPORTANCE OF VENDOR/INDUSTRY CERTIFICATION

PREFERRED METHODS OF IT SKILL ACQUISITION

INCUMBENT WORKER TRAINING

MODEL CURRICULA & SKILL STANDARDS

OHIO EMPLOYERS ON IT SKILL REQUIREMENTS

❖ KEY FINDINGS ❖

IT "generalists" are valued by many Ohio employers.

Three strands of skill requirements emerged from the literature review and focus group discussions with Ohio's employers including: Soft skills, Business skills, and Technical skills.

"Soft skills" including communication, customer service orientation, team skills, thinking skills, personal characteristics, flexibility/adaptability, and self learning skills are at a premium for IT workers.

Technical translation skills are imperative for all levels of IT workers.

There is increased demand for IT workers who have strong business skills. Most employers struggle with the inability of computer experts to apply technology to business applications.

Technical skill requirements vary by industry sector.

Work-based learning is strongly recommended by employers given the *industry specific* knowledge and applications that are required of IT workers.

Importance of vendor/industry certification for hiring (i.e., evidence of demonstrated IT ability through a particular vendor) received mixed reviews.

Non-technical skill certification is emerging and a possible area of new service delivery for the EnterpriseOhio Network.

There is strong preference for on-the-job training using defined curriculums.

In conducting the comprehensive literature review, three overall strands of IT skill requirements emerged: Soft skills, Business skills, and Technical skill requirements. In fact, the *Intersociety Study Group on IT Workers for the Computing Research Association* reported:

> An effective IT worker needs a variety of skills including **technical knowledge** about information technology, **business knowledge** and experience, and organizational and **communication skills**.[21]

While the language varies somewhat, other literature and IT frameworks have embraced the three overall strands of skills required of IT workers as well. An initiative in Ohio referred to as itWORKS.OHIO established an IT curriculum framework for high school and associate degree level education. Among the five IT Core Competencies of itWORKS.OHIO are critical thinking, problem solving, and communication skills (or many of the so-called soft skills); industry specific knowledge and experience (or business skills); and understanding of software/hardware installation/maintenance and ability to execute programming concepts (or technical skills).[22]

To build on what was learned from the comprehensive literature review, Ohio employers were asked through the focus group discussions:

- To describe the "ideal" IT worker
- The kind of skills IT job applicants and new hires typically lack
- The kind of technical training and experience IT workers need
- About the primary emphasis of IT education and training programs among two-year campuses when technical skills, business skills, and "soft" skills are considered

While not specific to any of the three primary skill sets, when asked to describe the ideal IT worker, many Ohio employers talked about the need for IT "generalists". Much of the need for IT generalists comes from small and medium sized employers who have smaller in-house IT staff and rely on these individuals for a variety of IT applications. These workers must have knowledge in all IT-related areas of work including maintenance, repair, networking applications, systems integration, web development etc., and are typically on call at all hours. For this reason, these workers are expected to be "generalists". This is also the probable reason for IT burn-out that so many employers referenced in the focus group discussions.

Even larger employers who have in-house IT departments are looking for IT "generalists". In this sense, employers want technical workers who can apply technology to a variety of business applications. In other words, the IT worker should be able to generalize technology solutions to all types of business strategies.

Some employers also described IT "generalists" as individuals who are well versed in a variety of programs, programming languages and other applications. The ideal worker will understand that technological advances occur every few months which requires them to adapt to new technologies and new products. This means IT workers must understand the basic concepts associated with operating systems, spreadsheets, databases, networking systems, programming, or any other specialty area, but also must be adaptable to learning more than one application. As the Washington

[21] The Computing Research Association. 1999.

[22] itWORKS.OHIO, JointCouncil of the Ohio Board of Regents and the State Board of Education.

Post reported, "instead of living with one programming language for a career, as a COBOL programmer expected to do in the 60's, tech employees are looking at a lifetime where they may use 15 or 20 languages. They'll need an academic background and a mind set so that a particular language isn't a life's work, it's just the tool of the moment".[23]

Some Ohio employers also believe we will move into an era where IT areas of specialty no longer existence, that the effective IT worker will be capable of transcending all areas of IT-related work.

IT "GENERALISTS" VALUED BY OHIO EMPLOYERS

"We need IT generalists . . . they have to do it all - PC repair, installation, networking, etc." *Ohio Banking/Finance Representative*

"The IT world is like medicine, there will be so many specialists and no one will be a general practitioner anymore . . . an IT person should be a generalist." *Ohio Not-for-Profit Provider*

"We need generalists with good business sense . . . We're starting to see a split in the IT industry . . . the consultant groups are the high technical people, the IT worker we need and want to keep, has to be a generalist . . . this person has to know the links to the business . . . We're moving toward generalists inside the companies and specialists external to the company." *Ohio Manufacturer*

"I don't look to colleges for specific technical skill training but for them to create generalists who can apply technological concepts." *Ohio Manufacturer*

customer service skills was evident.

Somewhat similar in concept, Ohio employers are also looking for IT workers empowered with **team skills**. Within the IT world there are many applications which involve project level work. This means IT workers in one specialty area must work closely with IT workers from another specialty area as well as business management teams and others for successful implementation of large IT projects.

Thinking skills are yet another area frequently mentioned by employers as critical to the nature of IT work. A computer support, maintenance technician, for example, must be able to engage in effective **problem solving** as should other IT workers who are required to "troubleshoot" when systems fail, need upgrading, testing, and full day to day administration. At the same time, **creative thinking** is at a premium for IT personnel like Web Designers.

Probably referenced most often in the focus group discussions with Ohio employers were **personal characteristics like initiative, versatility, adaptability, flexibility, commitment, responsibility, integrity, attitude, patience, detail orientation, and respect for authority.** Adaptability and flexibility are a necessity, not only in the context of keeping pace with new technology products and applications, but in terms of applying technology to evolving business goals and strategies. Integrity was mentioned in relation to IT workers having access to sensitive and confidential records for individual companies.

In addition, employers are seeking individuals with strong ability to engage in **self-learning.** This relates directly to the need for keeping pace with the lastest technology applications, which employers have little time to attend to. IT workers are expected to develop their own proficiency in new products and applications for the company.

SOFT-SKILL REQUIREMENTS:

"Because agencies are trying to build lasting relationships with their clients, they're seeking individuals who can help deliver a full-service solution. It's not enough to send in a body who can churn out Microsoft's Visual Basic programs - agencies need developers who can advise clients on why they need these programs. And not only must developers advise clients, they must do it with a measure of diplomacy and finesse." [24] The same attitude was reflected by Ohio employers as well. Throughout the discussions, employers reiterated how IT workers must be able to communicate with co-workers and customers. The strong desire for **communication** and

SOFT SKILLS MENTIONED BY OHIO EMPLOYERS

Communication Skills	Personal Characteristics
Listening Skills	Initiative
Public Speaking	Versatility
Writing/Technical Documentation	Commitment/Responsibility
Technical Translation	Integrity
Customer Service Orientation	Attitude
	Patience
	Detail Orientation
Team Skills	Respect for Authority
	Flexibility/Adaptability
Thinking Skills	
Analytical/Rationale Thinking	Self-Learning SKills
Problem Solving Skills	
Creative Thinking	Work Ethic/Reliability

[23] *"Getting It Right on the Money; An Online Survey of Salaries for Technology Workers Reveals a Career Field in Flux"*, Peter Behr, Washington Post Staff Writer, September 21, 1998.

[24] ***Tim Bradshaw, Interim Technologies in Houston; Quoted in "Computerworld 2nd Annual Consultants Salary Survey", BusinessSpecial Report, Computerworld, May 24, 1999.***

There is one other area of soft skill development which deserves special attention and was an underlying theme of all focus group discussions conducted on behalf of the EnterpriseOhio Network. Employers referred over and over to the ability of IT workers to be proficient as **technical translators.** Like Ohio employers, technical translation skills have been a topic of conversation at the national level. An employer quoted in *ComputerWorld* in 1999 said, "technical skills can usually be learned, but it's hard to find those candidates hat can be great coders and great communicators at the same."

Because IT workers are required to work with a variety of end-users, including customers and co-workers, most employers feel that they must be able translate technical concepts in very user-friendly ways. In fact, many Ohio employers said that job applicants and current IT workers currently lack the ability to communicate technical jargon in terms that others can understand.

There is also some concern that IT workers have a tendency to promote themselves as superior to co-workers and customers when communicating technical concepts. Many indicated there is intentional effort to make others "feel dumb" about technology. Businesses are actively seeking workers who are willing to share their technical knowledge with others. They believe information sharing makes an IT worker more valuable. Unfortunately, employers have encountered some IT workers who believe withholding information or "expertise" contributes to job security.

According to Ohio employers, technical translation skills have become an area of dramatic skill deficiency. Most recommend that the ability to translate technical knowledge willingly and concisely be a strong component of IT education and training programs.

"SOFT" SKILLS AT A PREMIUM

"Many are adequately trained for technical work, but their interpersonal skills are so obviously lacking that it's hard to place them in the workforce". *Ohio Banking/Finance Representative*

"Technical specialists are often more in tune with machinery than people". *Ohio Manufacturer*

"I have to get rid of more people because they lack people skills than because they lack technical know-how". *Ohio Government Official*

"IT situations are often volatile and an IT worker must have good communication skills to deal with these types of daily occasions". *Ohio Manufacturer*

"You can provide all the technology in the world, if it doesn't make sense to the user, it's useless". *Ohio Manufacturer*

"You can have a degree in IT or anything but unless you have the people skills to build relationships within the company and with customers, it means nothing". *Ohio Retailer*

"We can teach the technical skills, especially when our environment is often very different from the learning environment. All businesses will vary in the programs they use. What we really like is for someone who is professional and has good soft skills". *Ohio Retailer*

"We all need those individuals, the Bill Gates of the world, but we usually have to keep them in the basement". *Ohio Health Care Provider*

"One of the biggest skills I look for in IT people when we hire are their people skills. I can teach the technical skills". *Ohio Architecture/Engineering Service Provider*

"With the nature of the work, we should not prepare IT workers to be introverts". *Ohio Government Official*

"Any time you pick an area to train people in it becomes obsolete. We need to train self-learning individuals and point them toward their own interests". *Ohio Government Official*

"I think IT workers should be able to switch from one job to another fairly quickly without losing track where they are at. They have to be very flexible". *Ohio Utilities/Communications Representative*

TECHNICAL TRANSLATION SKILLS IMPERATIVE

"An ideal IT worker is someone who can come down to the level of people they are trying to help." *Ohio Health Care Provider*

"Ability to explain to other people is critical." *Ohio Not-for-Profit Provider*

"IT workers must posses a willingness to transfer knowledge to others." *Ohio Government Official*

"IT workers should be willing to talk about individual needs and not concern co-workers with technical jargon." *Ohio Retailer*

"Effective IT workers can relay their expertise in layman's terms." *Ohio Trucking/Warehousing Representative*

"IT workers must be able to communicate at all levels of an organization in terms that people can understand." *Ohio Manufacturer*

"Sometimes people think withholding information is job security, but today, sharing information makes you more valuable." *Ohio Government Official*

"IT person needs to be able to extract the information from co-workers to solve the problem." *Ohio Architecture/Engineering Service Provider*

"IT workers need to be able to transcend the computer handicapped, to show nurses and others how their computer works and the shortest way of getting where they want to be." *Ohio Health Care Provider*

"An ideal IT worker is someone who is personable enough to ask you the right questions and doesn't make you feel like an idiot because of the questions you ask. Most can't communicate or understand individual needs." *Ohio Banking/Finance Representative*

"IT workers are not usually the best trainers. They need to communicate in a way that doesn't make others feel dumb." *Ohio Trucking/Warehousing Representative*

"You can hire the brightest person in the technology world, but if they can't convey their understanding, they're useless." *Ohio Health Care Provider*

BUSINESS SKILLS:

"As companies rely more and more on IT to increase their competitiveness, they become more and more adamant that IT professionals possess business know-how . . . More and more companies are hiring contractors to fill technical needs and nurturing a business understanding among their full-time, and hopefully, long term IT staff."[25] Like national employers, Ohio employers discussed the increased demand for IT workers with strong business skills. Many of these skills are similar to those traditionally taught in a business management program like project management skills, time managements skills, organizational skills, prioritization skills, budget formulation skills, cost/benefit analysis, company profitability, and technical writing including proposal and report development. However, most employers are looking for individuals who have knowledge and experience within a particular industry setting, can understand the corporate mission and goals, and most important can make technology work specifically for the business.

In fact, employers frequently describe technical skills as secondary to business skills. Business skills are so important that employers are beginning to hire only those IT workers with good business sense as permanent employees. They are out-sourcing to consultants and independent contractors work that is strictly technical and computer-based. One national employer said, "Renewed emphasis on business skills is part of a larger trend, it's more important that the person understands claims processing, than having C++ experience."[26]

It is apparent from the summary by industry sector that technology applications vary from one industry to another. For example, electronic patient charting, computerized medical records, and reporting systems resulting from managed care and government mandates are technology applications for health care providers. Without specific knowledge of this industry, relating technology to business efficiency and productivity are challenging. The same is true for other industry sectors. This means modification or development of new IT education and training programs across the EnterpriseOhio Network should embrace industry-specific applications. This also implies a strong need for the integration of IT learning across all academic disciplines, not just those focused on IT areas of specialty.

BUSINESS SKILLS
MENTIONED BY OHIO EMPLOYERS

Project Management Skills	End User Knowledge & Focus
Time Management Skills	Supply Chain Knowledge
Organization Skills	Proposal, Report Development
Prioritization Skills	Business Specification, Recommendation Development
Budget Formulation	Importance of Corporate Culture
Cost/Benefit Analysis	Understanding of company "big picture"
Company Profitability	

Industry Specific Knowledge and Experience

BUSINESS SKILLS INCREASINGLY IMPORTANT FOR PERMANENT IT EMPLOYMENT

"Technical skills are almost secondary, business fit is mandatory." ***Ohio Manufacturer***

"Workers need an understanding and appreciation for how their work can impact ten different departments." ***Ohio Utilities/Communication Representative***

"People coming in today are very aware of technology but don't understand business in the least." ***Ohio Manufacturer***

"IT workers must understand and determine how technology can help the business." ***Ohio Manufacturer***

"It's not a matter of which programming language individuals should be trained in but an understanding of what the programming language is used for that's important." ***Ohio Utilities/Communications Representative***

"IT workers ought to be looking at the challenges of changing jobs every few years . . . not only should they be up to snuff on technology but also in areas of business management given the different businesses they'll be serving." ***Ohio Manufacturer***

"Help these workers understand that it's not technology for the sake of technology, it's technology for the sake of business." ***Ohio Manufacturer***

"Technology workers need to understand the role systems play within the business and the unit cost of completing a job . . . the impact on a company's bottom line or profitability." ***Ohio Utilities/Communications Representative***

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[25] *"Contractors Need Not Apply"*, by Mary Brandel, ComputerWorld, July 5, 1999.

[26] ComputerWorld, July 5, 1999.

ECHNICAL SKILLS:

Referring to IT technical skills, ComputerWorld Inc., reported, "Technology may be changing at the speed of light, but the skills that are most in demand are surprisingly familiar".[27] This means that while new computer languages and software applications are being introduced rapidly, many employers are still using applications that were common more than 20 years ago. COBOL programming for example, is still utilized nationally and among Ohio employers. As indicated in Chapter 2, employers feel a need to keep pace with new developments for fear they won't be as competitive, won't be able to attract the best IT workers, or are being mandated to install specific systems for reporting purposes. Yet, one of the lessons learned is system upgrades are not only expensive in equipment and staff training, but some have realized old systems served the company well.

Because the conversations among Ohio employers were consumed by the need for soft and business skills, few recommendations were made to the EnterpriseOhio Network in terms of technical skill development. There were, however, hints of both old and new technical applications being utilized across Ohio. The text box to the right describes the more common technical knowledge employers require nationally.[28] Some Ohio employers referenced COBOL programming, Oracle, Microsoft NT and Novell Netware for LAN administration, HTML and Java experience for Internet applications, and Novell GroupWise for office exchange purposes all of which are compatible with national technical skill requirements.

Literature reveals that the use of technical tools is often driven by industry specific needs and applications and depends on the technological sophistication of each individual company. Thus, it is very difficult for education/training providers to select the technical languages and applications to best train IT workers, unless training is tailored to specific IT jobs and industry sectors. The ITAA survey of employers also revealed that technical skill requirements vary dramatically by IT job and industry cluster.

Selection of Novell or Microsoft to prepare Network Administrators, while a constant concern for education/training providers, did not seem as critical to Ohio employers. The concern is not so much which application individuals are prepared in, but more their ability to apply technical tools for business purposes and to adapt to new applications as they are developed. Basic understanding of word processing, spreadsheet, database applications, networking software, programming languages, etc., and what each of these applications is intended to accomplish, seems to be more important to employers than the vendor specific application that should be used. IT workers are expected to be self-learners and employers are willing to train workers in new technological applications as they surface. While IT workers must have some base of technical skills, education and training providers should focus on more on the basic concepts and applications of the technology.

COMMON TECHNICAL KNOWLEDGE BY IT FUNCTION

INTERNET SKILLS	NETWORKING
Net Development	TCP/IP
HTML	SNA
Java	IPX
Web Server Administration	Wan-wise
	LU6.2
INTERNETWORKING	**LAN ADMINISTRATION**
10Base-T switching	Microsoft NT Server
Ethernet switching	Novell Netware
Routing	Ethernet
ATM	HTTP
Gigabit Ethernet	Apple Talk
LANGUAGES	**DBMS AND RDMS**
COBOL	Oracle
C++	Microsoft SQL Server
C	DB2
Micro Focus Cobol	Sybase SQL Server
Smalltalk	Informix
DEVELOPMENT TOOLS	**OPERATING SYSTEMS**
Visual Basic	Windows NT
Oracle Developer 2000	Windows 95
Visual C++	Unix
Power Builder	Solaris
Visual J++	HP-UX
CLIENT/SERVER APPLICATIONS	**OFFICE/E-MAIL/GROUPWARE**
Oracle	Microsoft Exchange
PeopleSoft	Lotus Notes
SAP	CC: Mail
J.D. Edwards	Novell Group Wise
Lawson	

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[27] "Contractors Need Not Apply", by Mary Brandel, ComputerWorld, July 5, 1999.

[28] "Matches Made in Heaven", by Deborah Radcliff, ComputerWorld, November, 16, 1999

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IMPORTANCE OF WORK-BASED LEARNING

It is the focus on business skill development and industry-specific knowledge/experience that is driving the preference for work-based learning within education and training programs. Many Ohio employers strongly advocated that students be required to fulfill some kind of cooperative learning experience, internship, job mentoring, job shadowing or other kind work related experience during their educational experience.

The need for work based learning was discussed by nearly all industry sectors of Ohio, but was particularly strong among manufacturers, public utility/communications companies, architecture/engineering firms, government and not-for-profit organizations. Employers felt that work based learning would not only strengthen the ability to apply technical skills within a business setting, but would also help workers experience how soft skill and business skills are used in real world situations. Government officials, for example, said IT workers "need project based learning". Within this group, the employers devised a work based application whereby a team students would be required to solve a technical problem, but also document and present their plan to a board of trustees. This, employers felt, would force students to use team skills, writing skills, public speaking skills and other skills necessary for survival in a business setting.

While it is often difficult for education/training providers to engage employers in these kind of partnerships, Ohio employers did see their involvement in work-based learning partnerships as a valuable recruitment tool and might be more willing to host such programs for prospective IT workers. Real world learning applications are strongly encouraged by Ohio employers for all education/training programs offered by the EnterpriseOhio Network.

WORK BASED LEARNING RECOMMENDED FOR IT STUDENTS

"Allow IT students to experience the real world and apply learning to real business settings." ***Ohio Not-for-Profit Provider***

"Co-ops bring a person into your office and it's almost like hiring from within. They need to understand what we are trying to accomplish. Having a co-op program would allow them to get a feel for what architecture is all about , what we are trying to accomplish with our system." ***Ohio Architecture/Engineering Representative***

"Need project learning, a technical component that is taken into the world . . . A team of students should have to solve a technical problem but also present to a board made up of several industries. They should have to demonstrate all their skills: technical ability but also public speaking skills, grammar, attire, professionalism, etc." ***Ohio Government Representative***

"They have good technical skills but they don't have any experience with job skills so to speak. Co-ops or work study opportunities provide better training than two to four years of school and offer a potential employee to the company." ***Ohio Utilities/Communications Representative***

"To help produce a qualified supply of IT workers throughout the state of Ohio, two-year campuses should provide internships. They are invaluable and show students what the real needs are." ***Ohio Manufacturer***

"Two year campuses should provide internship programs so students have a commitment to the organization and the work that the organization performs. Students with this exposure are willing to put forth an extra effort to complete tasks." ***Ohio Manufacturer***

"I'm finding people right out of school have good CAD skills, but the IT people don't have experience. I would like to see the two-year schools go more along the lines of co-ops, interns, work study partnerships. Work experience should be built into the curriculum. I'll give them 30 hours a week and I'll give them flexible work schedules so they can continue to go to school." ***Ohio Architecture/Engineering Representative***

IMPORTANCE OF VENDOR/INDUSTRY CERTIFICATION

Many sources report higher salaries for individuals certified in vendor/industry specific applications. However, caution must be exercised in using this data since it is usually reported by vendors trying to sell certification programs to prospective IT workers and education/training providers.

A+, Microsoft, and CISCO are but a few of the certification programs available through the Internet and other sources, including Ohio's two year campuses. But the key questions are whether or not certification adequately prepares IT learners for work and whether certification signifies or conveys to employers that IT workers know how to perform their work well. The answer to these questions are mixed.

The *Information Technology Association of America* revealed that certification is of "moderate" importance only. One half of all employers rated vendor/industry certification as important to recruitment and hiring practices while one half did not.[29] Ohio employers were asked as part of the focus group discussions to comment on vendor/industry certification as well. Some indicated that certification is evidence that a prospective worker has a good knowledge base and skill set for successful job performance. Some went so far as to say that this conveys more to an employer than a degree does. Other Ohio employers, however, contend that certification does not tell them much about prospective workers skill sets or probable job performance, and that the soft and business skills discussed are more important. Still others questioned why education and training providers would invest in certification when employers can get people certified in the same area in much less time than an institution of higher education. One employer said, "Certification makes great headlines for two-year campuses but I can get people certified in a week, not a quarter".

For fear of losing their competitive edge, much in the same way employers are, education and training providers will most likely continue to host and develop these programs, particularly if interest and enrollment is steady among individual learners. However, the investment in development of certification programs by two year campuses should be carefully weighed with the benefit to employer-customers and IT learners in mind. Right now, there is no majority consensus on these perceived benefits.

In addition to mixed views on the value of IT certification, it is important to recognize that technical skill development, while certainly important, is but one of three areas of skill acquisition necessary for good job performance. Given the need for soft skill development, many are experimenting with soft skill certification. In fact, the *National Alliance of Business* is promoting non-technical skill certification:

> Market driven, competency-based skills certificates quickly communicate what people know and can do - and one day may help communicate about knowledge and skills among k-12 schools, postsecondary schools, workforce training programs and employers.[30]

NAB indicates that skill certificates are beneficial to both employers and workers. "For employers, they represent specific skills that give employers a time saving way to assess the competencies of potential workers. For employees, certificates offer a valuable alternative or add-on to academic degrees to increase and demonstrate their marketable competencies". In fact the certificates are referred to by NAB as "stackable" credentials whereby "they can stand alone or fit like puzzle pieces with other certificates and credentials to build a portable toolkit for the certificate holder".

Most important in the context of recent research findings, skill certificates embrace "soft" skill development and which means there is increasing momentum that skill certification is possible in communication, problem solving, observing, listening, locating information, teamwork and other areas of importance to employers. Certification is not intended to be "a crash course for three weeks to make up for what wasn't learned for 12 years of schooling". Most see this as a model that relies on K-12 integration and achievement.

Skill certification is emerging in soft skill areas and has been directly related to the preparation of IT workers given the foundational skills required for these jobs. ***This is a possible area of new service delivery among the EnterpriseOhio campuses.***

OHIO EMPLOYERS ON THE IMPORTANCE OF VENDOR/INDUSTRY SPECIFIC CERTIFICATION

"Certifications are great when you're outsourcing because you know they have the skills when they're coming in, but you don't look for that when you hire someone".

"Certification is a side thing. It's like getting a bachelors or an associates degree. Skills we have talked about are more important".

"You have people with certifications who don't know the difference between and ISDN line and T1 line".

"Certification makes great headlines but I can get people certified in one week. They don't need a whole quarter to do this".

"I think certifications are more important to the business community than associate degrees. Microsoft, A+, and other certifications tell us you know how to do something which is more valuable than a business degree".

[29] "Bridging the Gap: IT Skills for a New Millennium", ITAA, 2000.

[30] *Work America*, National Alliance of Business, March 2000.

PEFERRED METHODS OF IT SKILL ACQUISITION & IMPORTANCE OF INCUMBENT WORKER TRAINING

PREFERRED METHODS OF SKILL ACQUISITION:

In addition to job outlook, IT skill requirements, and the importance of vendor/industry certification, the recent survey of U.S. employers conducted by the *Information Technology Association of America* "offered insights on employer preferred training approaches". First, employers were asked to rate sources of skill acquisition. Key findings were as follows:

- Employers identified a large number of methods to acquire skills including four-year colleges, private technical institutes, seminars and short courses, informal training and community colleges.
- Four-year colleges and private technical institutes were rated highest among pre-hire methods when comparing all types of IT positions.
- Short courses and seminars, informal training, and community colleges were rated highest among pre-hire skill acquisition methods when analyzing specific positions like Web Development.[31]

While traditional training providers are considered "effective", the study also found that employers "believe these organizations can improve their offerings too".[32] More important, when ranking different alternatives, companies expressed a strong preference for creating their own formal, on-the-job training programs. In fact, post-hire training was considered significantly more effective than pre-hire methods of training. A majority of managers (84%) rated training after an employee is hired as effective or very effective compared to 41% rating pre-hire training high. Managers strongly preferred on-the-job training when it has a structured format and defined curriculum. *This could have strong implications for enhanced service delivery among the EnterpriseOhio Network given it's track record for contracted training services to Ohio employers.*

INCUMBENT WORKER TRAINING:

While Ohio employers were not asked to discuss pre and post hire methods of skill acquisition, incumbent worker training was another underlying theme of the focus group discussions. First, when asked to comment on their greatest IT struggles, nearly all industry sectors referenced staff training. As employers integrate computer systems across the entire business process, worker training will continue to be a great necessity. Most employers, while not doubting the need for workers trained in IT areas of specialty, described how all incumbent workers will need to have some level of technology literacy. They also thought that improving technological competencies among incumbent workers might ease daily support services to co-workers by IT staff, especially when this is done above and beyond other job responsibilities often causing burn-out and loss of IT talent for the company.

Ohio employers also discussed an interest in growing their own IT workers from existing pools of workers given the cost associated with recruitment and turnover of IT workers. They also thought this would improve the relationship of IT workers to business processes and functions. ***Employers expect an increase in worker training and see the two-year campuses of Ohio as a valuable resource in this area.***

OHIO EMPLOYERS ON INCUMBENT WORKER TRAINING

Incumbent worker training was described across all industry sectors as the greatest IT struggle.

Employers will continue to integrate computer systems across the entire business process making worker training a great necessity.

Improving the technological literacy of incumbent workers is viewed as one way of minimizing daily support services by IT staff to co-workers.

Employers have an interest in growing their own IT workers out of existing labor pools given:

- Cost associated with recruitment and turnover of IT workers
- Improves the relationship of IT work to business processes and functions (since incumbent workers are more familiar with business applications)

Ohio employers expect an increase in worker training and see the two-year campuses as a valuable resource.

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31 *"Bridging the Gap: IT Skills for a New Millennium"*, ITAA, 2000

32 Ibid.

MODEL CURRICULA & SKILL STANDARDS

In conducting the comprehensive literature review and environmental scan, some model curricula, skill standards, and skill assessment tools were identified around information technology. While not all encompassing, the following is a summary of some of the more high profile efforts surfacing across the nation. For the EnterpriseOhio Network, this means a variety of resources are currently available for the development and modification of IT programs.

IT CURRICULA & SKILL STANDARDS:

*it*WORKS.OHIO is "based on a curricular framework which includes a comprehensive set of IT competencies that are grounded in core academic subject areas".[33] Four overall strands or career clusters are included in the framework:

- Information Support and Services
- Networking Systems
- Interactive Media
- Programming and Software Development.

"For each of these strands, business and industry representatives identified competencies or skills needed by entry level IT professionals. These competencies then provide a profile of what students should know and be able to do at the end of high school and the associate degree to ensure success in Ohio's New Economy"[34]

Building Linkages in Information Technology is a new initiative of the Education Development Center, Inc., the Information Technology Association of American (ITAA), and the National Alliance of Business (NAB). The project will develop a "career cluster model for IT which links IT skill standards (what IT workers need to know and be able to do to succeed in the workplace) with academic and technology learning standards in schools".[35] The project is intended to map existing resources including standards, curricula, assessments, and certifications, to identify gaps in quality curriculum, and to focus development in areas that fill these gaps. "Nine IT career cluster dissemination sites are being selected to test the model and its related curricula, assessments and record keeping systems, evaluate the effectiveness of this model and share experiences with the field."[36]

The Information Systems-Centric Curriculum (ISCC) '99 is a curriculum "to prepare information specialists for the development and use of large information systems." According to the developers, ISCC'99 prepares graduates to identify information systems solutions to large problems, and communicate their concepts to others:

> The graduate of the curriculum will decompose problems, develop alternative solutions, evaluate alternatives, conceptualize designs, build, test, validate, and deliver large or complex information systems in a team environment. They will also understand the social implications of their actions.[37]

A comprehensive set of skill standards for Information Technology were developed by the ***NorthWest Center for Emerging Technologies and the Regional Advanced Technology Education Consortium*** at Bellevue Community College in Washington. According to the Consortium, these skill standards answer two critical questions:

- What do workers need to know and be able to do to succeed in today's workplace?
- How do we know when workers are performing well?

The standards were developed around eight IT career clusters, many of which are comparable to the IT framework used to gather information from Ohio employers. These career clusters include:

- Database Administration Associates
- Information Systems Operators/Analysts
- Interactive Digital Media Specialists
- Network Specialists
- Programmers/Analysts
- Software Engineers
- Technical Support Representatives
- Technical Writers

For each of these clusters, detail is provided for three broad skill categories including Foundation skills, knowledge, abilities, and personal qualities; Technical skills, knowledge, and abilities; and Industry-specific technical skills, knowledge, and abilities. Included for each of these eight clusters are descriptions, examples of job titles, lists of work related functions and tasks, work scenarios, and skill standards charts. The standards are intended to assist educators in developing new and evaluating existing curriculum and programs based on industry needs. They are also intended to help

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[33] itWORKS.OHIO, Ohio Board of Regents and Ohio Department of Education, 1999.

[34] Ibid.

[35] Building Linkages in IT Pilot Site Package, Education Development Center Inc., 2000.

[36] Ibid.

[37] ISCC'99 Program Guidelines for Educating the Next Generation of Information Systems Specialists in Collaboration with Industry, Developed by a Collaborative Academe/Industry Task Force with Support from the National Science Foundation, July 1999.

set benchmarks for competent student performance.[37]

SKILL ASSESSMENT TOOLS:

The **National Computer Systems (NCS)** has designed and developed with involvement from the IT industry a new IT workforce assessment system. NCS has two assessment batteries one of which measures basic IT competencies and one which measures advanced IT competencies. In addition to the IT assessment instruments, NCS has developed a consortium to provide clients with a comprehensive IT Workforce Development System (IT-WDS). The IT-WDS provides direct links to the best training and education systems including competency models, assessment instruments, certified courseware, individual development plans, and rosters of highly qualified applicants for employers. The IT-WDS also includes a paid internship program.[39]

Tek.Xam is a new standardized exam testing the computer skills of college students and incumbent workers created by the VA Foundation for Independent Colleges. The assessment measures problem-solving skills within the technology environment. It is an Internet-based, vendor neutral test delivered online in a proctored computer lab. According to the developers, Tek.Xam credentialed individuals can synthesize and analyze data, draw conclusions, and present those conclusions using a variety of common computer applications. They can also create websites and can effectively use the Internet for information gathering and analysis. In addition, they understand a wid erange of computer concepts related to networking, hardware and software as well as the key legal and ethical issues associated with the use of th's technology.[40]

EDUCATION FRAMEWORK FOR IT SKILL INTEGRATION:
Incorporating all three skill sets into IT education and training programs can be overwhelming, particularly when individuals have less time to devote to their training and are demanding accelerated learning. *The Computing Research Association* developed an education and training framework which consists of four primary types of IT-related work to help educators understand how skill requirements vary by IT function. Their framework consists of four overall functions of IT workers:

- **Conceptualizers** conceive of and sketch out the basic nature of a system artifact.
- **Developers** specify, design, construct, and test an IT artifact.
- **Modifiers/Extenders** modify or add onto an IT artifact.
- **Supporters/Teachers** deliver, install, operate, maintain, or repair an IT artifact.

While Ohio employers had a difficult time prioritizing the three strands of skill requirements for IT workers, CRA, using a scale of 1 to 4, where1 was least important and 4 was critically important, was able to prioritize each set of skill requirements for each of these overall classifications. For example, technical skills are most important for conceptualizers, or those who actually invent computer-based systems, but not as critical for other areas of IT-related work. For IT developers, or those who design and test new applications for computer-based systems, both technical skills and soft skills ranked the highest with a score of 3 for each. Modifiers and extenders, or those who relate computer systems to the needs of end users needs or specific business applications must have greater business skill acquisition than other types of IT workers. For supporters/teachers or those who perform IT services for others and must interact with customers/co-workers on a continual basis, soft skills in areas like communication are more important.

	Technical	Business	Communica-tion
Conceptualizers	4	2	3
Developers	3	2	3
Modifiers/ Extenders	2	3	3
Supporters/ Teachers	2	3	3

1= least important; 2 = moderately important; 3= important; 4=critically important. *CRA, 1999.*

Today, much education and training of IT workers focuses on technical skill development. The EnterpriseOhio Network should heavily consider integration of soft and business skill development into IT programs. Coupled with work based experience, this will produce workers who are uniquely qualified and valued by Ohio employers. Most of the model curricula and skills standards available also embrace these skill sets.

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[38] "Building a Foundation for Tomorrow: Skills Standards for Information Technology", Northwest Center for Emerging Technologies and the Regional Advanced Technology Education Consortium, Bellevue Community College, Bellevue Washington.

[39] NCS Workforce Development Group, ncs1bc@aol.com

[40] Virginia Community College System, 2000.

SUPPLY OF INFORMATION TECHNOLOGY WORKERS

TREND ANALYSIS: OHIO COMPARED TO THE U.S.

ANALYSIS FRAMEWORK

PROGRAM DEFINITIONS

PRODUCTION OF ALL IT WORKERS

AWARDS OF LESS THAN TWO YEARS

ASSOCIATE DEGREE PRODUCTION

BACHELOR DEGREE PRODUCTION

ADVANCED DEGREE PRODUCTION

ANALYSIS FRAMEWORK: SUPPLY OF INFORMATION TECHNOLOGY WORKERS

Ohio Compared to the U.S.

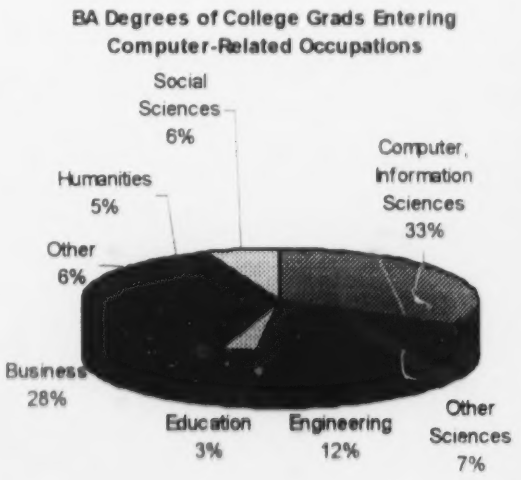
In addition to the capacity inventory conducted among the EnterpriseOhio Network, a trend analysis on the supply of IT workers was conducted. The framework for this trend analysis was driven primarily by availability of data. The *National Center for Education Statistics* (NCES) tracks the number and nature of post secondary education/training awards granted each academic year. This source of data was used so that Ohio could be compared to the nation, providing an important context for interpretation of results.

There are, however, some limitations to the NCES data. First, the most current data available is for academic year 1995-96. Where possible, longitudinal data has been used to identify trends in the production of IT workers. Second, IT programs of study are not succinctly defined by NCES. A classification scheme was devised from available categories of education and training programs to determine where Ohio stands in its' production of IT workers relative to the nation.

Six overall clusters of IT education/training programs of study were included in this analysis: Business Information Systems, Computer Engineering, Computer Information Sciences, Computer Installation/Repair, Graphic Arts/Publishing, and Computer Teacher Education. These six clusters combined represent the production of all IT related workers in Ohio and the U.S. based on this data source. In addition to degree programs, NCES tracks awards of less than two years including non-credit and certificate programs. The NCES supply network consists not only of institutions of higher education but other adult training providers like Vocational Education Career Centers (i.e., JVS's).

IT Clusters (Programs of Study)	NCES Levels of Award
Business Information Systems	Less than one year
Computer Engineering	More than one year but less than two years
Computer Information Sciences	Associate Degrees
Computer Installation and Repair	Bachelor Degrees
Graphic Arts and Publishing	Master's Degrees
Computer Teacher Education	Doctorate Degrees

While the six clusters examined include 25 separate programs of IT related study, and are much more inclusive than prior studies which emphasize four-year and graduate training in Computer Science only, there is evidence that the IT workforce comes from a variety of non-IT related disciplines.[1] According to *The Urban Institute*, as much as one-quarter of all IT workers are graduates of Social Science, Humanities, Other Sciences, and other non-IT disciplines. Unfortunately, there is no source of data that comprehensively tracks the number of graduates from non-IT disciplines who secure IT jobs. *This means the estimates of IT worker production within this analysis are somewhat conservative.* It also lends further support that information technology should be integrated into all academic disciplines among Ohio's two year campuses.



[1] "Emerging Trends in the IT Job Market: How Should the Public and Private Sectors Respond", Dr. Robert I. Lerman, The Urban Institute, Testimony before the Subcommittee on Oversight and Investigations Committee on Education and the Workforce, United States House of Representatives, April 23, 1998.

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IT PROGRAM DEFINITIONS:

Business Information Systems

Information Processing/Data Entry Technician (52.0407): Supports business information operations by using computer equipment to enter, process, and retrieve data for a wide variety of administrative purposes. Includes basic business software and hardware; business computer networking; principles of desktop publishing; preparing mass mailings; compiling and editing spreadsheets; list maintenance; preparing tables and graphs; receipt control; and preparing business performance reports.

Management Information Systems and Business Data Processing, General (52.1201): Provide and manage data systems and related facilities for processing and retrieving internal business information;; and responding to external data requests. Includes cost and accounting information systems, management control systems, personnel information systems, data storage and security, business systems networking, report preparation, computer facilities and equipment operation and maintenance, operator supervision and training, and management information systems policy and planning.

Business Computer Programming/Programmer (52.1202): Applying software theory and programming methods to the solution of business data problems. Includes designing customized software applications, prototype testing, documentation, input specification, and report generation.

Business Systems Analysis and Design (52.1203): Analyze business information needs and prepare specifications and requirements for appropriate data system solutions. Includes information requirements analysis, specification development and writing, prototype evaluation, and network application interfaces.

Business Systems Networking and Telecommunications (52.1204): Evaluates and resolves business data system hardware and software communication requirements. Includes electronic communications networks, telecommunications theory, network theory, hardware and software interfacing, computer network design and evaluation, distance communications systems, computer systems facilities and support design and evaluation, and applications to specific operational needs regarding voice, text, and data communications.

Business Computer Facilities Operator (52.1205): Operates mainframe computers and related peripheral equipment in business settings. Includes mainframe operation and monitoring, peripheral equipment operation and monitoring, disk and tape mounting and storage, printer operations, and related computer facility operations.

Business Information and Data Processing Services, Other (52.1299): Any program in business information and data processing services not described above.

Computer Engineering: Applying mathematical and scientific principles to the design, development, and operational evaluation of .

Computer Engineering (14.0901): Computer hardware and software systems and related equipment and facilities; and the analysis of specific problems of computer applications to various tasks.

Electrical, Electronics and Communications Engineering. (14.1001): Electrical, electronic and related communications systems and their components, including electrical power generation systems; and the analysis of problems such as superconduction, wave propagation, energy storage and retrieval, and reception and amplification.

Systems Engineering (14.2701): Total systems solutions to a wide variety of engineering problems, including the integration of human, physical, energy, communications, management, and information requirements as needed, and the application of requisite analytical methods to specific situations.

Computer Information Sciences

Computer and Information Sciences, General (11.0101): Study of data and information storage and processing systems, including hardware, software, basic design principles, user requirements analysis, and related economic and policy issues.

Computer Programming (11.0201): Applying methods and procedures used in designing and writing computer programs to developing solutions to specific operational problems and use requirements, including testing and trouble-shooting prototype software packages.

Data Processing Technology/Technician (11.0301): Prepares individuals to use and operate computers and associated software packages to perform a variety of tasks, including text processing, number processing, graphics, and data base management.

Information Sciences and Systems (11.0401): Scientific study and development of electronic systems for transmitting information via signalling networks, and the study of information transmission from the point of generation to reception and human interpretation. Includes information systems planning and design, user needs analysis, and provider capacity and requirements analysis.

Computer Systems Analysis (11.0501): Applying computer programming principles to the design and implementation of large-scale computer applications and networking systems. Includes instruction in system design, user prioritization, system and component optimization, and computer security systems.

Computer Science (11.0701): Scientific and mathematical study of the algorithms used in designing and building computers, and their application to the development and design of actual computing systems. Includes computer architecture, assembly and programming languages, numerical and computational analysis, computer systems theory, artificial intelligence and cybernetics, and simulation and modelling.

Computer and Information Sciences, Other (11.9999): Any program in computer and information sciences not described above.

Computer Installation & Repair

Computer Engineering Technology/Technician (15.0301): Applying basic engineering principles and technical skills in support of computer ???

Computer Maintenance Technology/Technician (15.0402): Applying basic engineering principles and technical skills in support of professionals who use computer systems. Includes instruction in basic computer design and architecture, programming, problems of specific computer applications, component and system maintenance and inspection procedures, hardware and software problem diagnosis and repair, and report preparation.

Computer Installer and Repairer (47.0104): Applying technical knowledge and skills to assemble, install, operate, maintain, and repair computers and related instruments. Includes instruction in power supplies, number systems, memory structure, buffers and registers, microprocessor design, peripheral equipment, programming, and networking.

Graphic Arts/Publishing Design

Graphic and Printing Equipment Operator, General (48.0201): Plans, prepares and executes commercial and industrial visual image and print products using mechanical, electronic, and digital graphic and printing equipment.

Computer Typography and Composition Equipment Operator (48.0211): Designs and executes page formats, layouts and text composition, and to make typographical selections using computer graphics and other computer-assisted design programs.

Desktop Publishing Equipment Operator (48.0212): An instructional program that prepares individuals to apply technical knowledge and skills to plan and execute entire publication tasks using desktop publishing equipment and software, including designing, printing and binding.

Graphic Design, Commercial Art and Illustration (50.0402): Use artistic techniques to effectively communicate ideas and information to business and consumer audiences via illustrations and other forms of printed media. Includes concept design, layout, paste-up, and techniques such as engraving, etching, silkscreen, lithography, offset, drawing and cartooning, painting, collage, and computer graphics.

Computer Teacher Education

Computer Teacher Education (13.1321): Prepares individuals to teach computer education programs at various educational levels.

PRODUCTION OF INFORMATION TECHNOLOGY WORKERS
Ohio Compared to the U.S.

◆ KEY FINDINGS ◆

Over a five year period, Ohio produced at least 22,000 workers who had some kind of formal education and training in IT related fields (awards of less than two years and IT degrees).

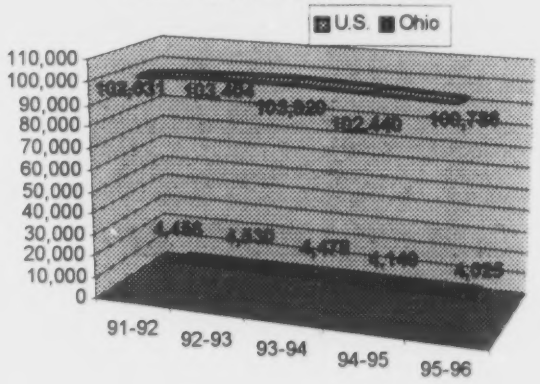
Ohio is 4% of the total U.S. population and also produced 4% of the nations degreed IT workers.

On average, Ohio produced proportionately more IT workers with Associate and Bachelor degrees and proportionately fewer IT workers with less than two year awards and Master's degrees than the U.S.

Proportionately, Ohio produces greater amounts of Business Information Systems graduates than does the U.S. which could be described as an asset for the state given increasing demand for IT workers with business skills.

The disparity in IT awards to minorities was greater in Ohio than the U.S. Minorities accounted for only 15% of the state's IT graduates compared to 32% of the nation's graduates.

IT Degree Production (Associate, Bachelor, Master, Doctorate Combined for All IT Clusters) Ohio Compared to U.S.



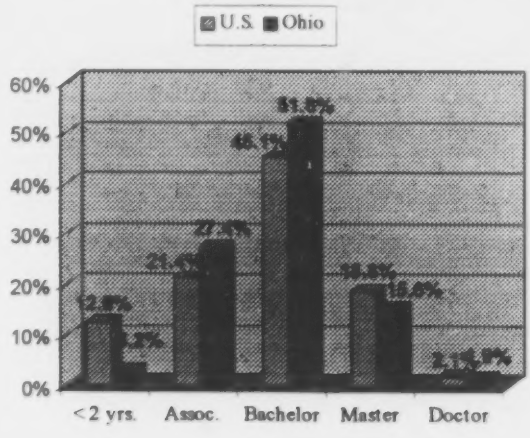
Level of IT Awards:

Proportionately fewer awards of less than two years have been granted in Ohio (3%) than the U.S. (13%). But, Ohio has produced slightly greater proportions of Associate and Bachelor degree holders in IT related fields. Like non-degree training, Ohio produced proportionately fewer IT workers with Master's degrees than did the nation. Production of IT workers with Doctorate degrees was proportionately similar for Ohio and the U.S.

Ohio constitutes 4% of the total U.S. population and over the five year period (1991-1996) also produced an average of 4.2% of the nations degreed IT workers (Associate, Bachelor, Master, and Doctorate combined). At least 4,000 degree holders were supplied by Ohio's institutions of higher education each year for a total of 21,640 IT workers over the five year period.

In addition, Ohio produced as many as _ workers with formal training, but no degree, in IT related fields (awards of less than two years). When added to the pool of *degreed* IT workers, Ohio is supplying a labor force of at least 22,000 workers who have some kind of formal education and training in IT fields. There was, however, a decrease in the number of IT workers produced each year for both Ohio and the U.S.

Level of IT Awards (5 year totals)



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Nature of IT Awards:

The greatest number of degrees granted in **Business Information Systems** (BIS) were at the *Associate Degree* level both in Ohio and the U.S. Some BIS awards were also made at bachelor, master, and doctorate levels. Between 1991 and 1996, the U.S. witnessed an increase in graduates each year while Ohio saw a decrease in overall numbers of graduates within this cluster. Ohio produced 6% of the nations BIS graduates over the five year period.

Most degrees in **Computer Engineering** (CE) were granted at the *Baccalaureate* level, but also master and doctorate levels. From 1991-1996, the number of graduates produced in this cluster remained steady for the U.S. but decreased each year for Ohio. Ohio produced 4% of the nations CE graduates over the five year period.

Computer Information Sciences (CIS) was the IT cluster to produce the most graduates for both Ohio and the nation between 1991 and 1996. Most CIS awards are granted at the *Baccaloriate* level, but were also common at all other degree levels. While the U.S. experienced a steady flow of graduates from year to year, Ohio witnessed a decrease in the number of graduates. Ohio produced 4% of the nations CIS graduates over this five year period.

Like BIS, **Computer Installation and Repair** (CIR) awards were most common at the *Associate degree* level. Interestingly, graduates of CIR are produced at bachelor and master levels across the nation, but not in Ohio. Both Ohio and the U.S. witnessed a decrease from year to year in the total number of graduates produced in this cluster. Ohio's CIR graduates constituted only 2% of the nation's graduates during this time.

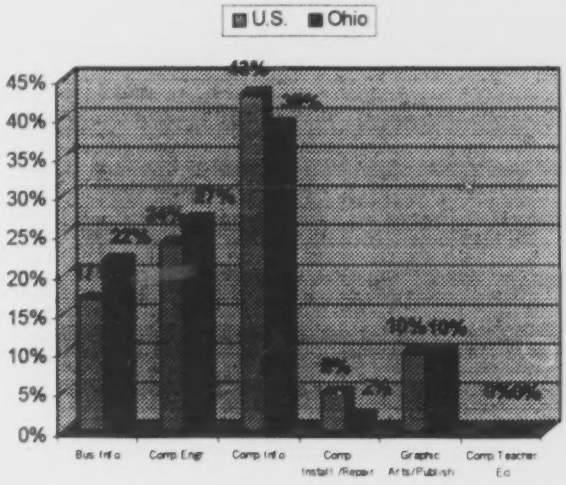
Most degrees in **Graphic Arts and Publishing** (GAP) were granted at the *Associate Degree* level with near as many at bachelor levels. Number of graduates produced across the nation remained steady each of these five years, but decreased in Ohio. Ohio granted 4% of the nations GAP degrees from 1991 to 1996.

Computer Teacher Education (CTE) degrees were most common at the Master's level throughout the U.S. In Ohio, however, most awards were made at the Bachelor's level. The U.S. witnessed an increase in the production of teachers with specialized education in Information Technology while production in Ohio (although small) was steady. Ohio produced only 2% of the nations CTE graduates over the five year period.

IT SUPPLY CLUSTERS	% GRADS PRODUCED BY OHIO (1991-1996)
COMBINED IT CLUSTERS	4%
Business Information Systems	6%
Computer Engineering	4%
Computer Information Sciences	2%
Computer Installation/Repair	2%
Graphic Arts/Publishing	4%
Computer Teacher Education	2%

Proportionately, Ohio produced slightly greater amounts of Business Information Systems and Computer Engineering graduates than did the U.S. In all other cluster areas, the U.S. and Ohio produced similar proportions of IT workers.

Nature of IT Degree Production In Ohio Compared to U.S. (5 year totals)



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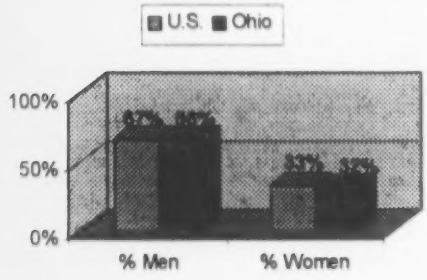
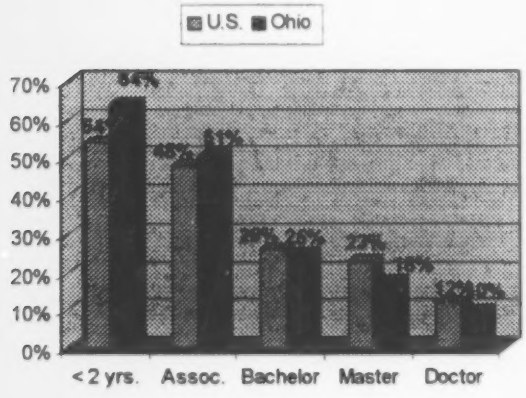
FEMALE DEGREE PRODUCTION IN IT FIELDS:

Approximately two-thirds of all IT awards were granted to men between 1991 and 1996 and only one-third to women. Not only have more men earned IT awards, educational attainment in IT fields was lower among women, particularly in Ohio. Among Ohioans receiving IT awards of less than two years, 64% were women. This exceeded the national figure of 54%. Likewise, 51% of those receiving IT Associate degrees in Ohio were women, slightly higher than the national figure of 48%. The percentage of women receiving IT Bachelor degrees in Ohio (25%) was nearly identical to the nation (26%). However, Ohio lagged the nation in the percentage of female IT graduates at Master and Doctorate levels. Almost one-quarter of the nation's IT Master's graduates were women (23%) compared to only 18% of Ohio's. Similarly, 12% of Doctoral graduates from IT programs across the nation were women compared to 10% of those earned in Ohio.

IT Graduates by Gender (All IT Clusters Combined by 5 year totals)

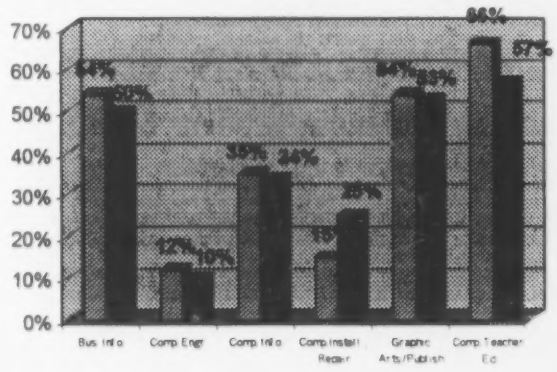


% Female Graduates by Level of IT Award (5 year totals)



Gender differences are also apparent by nature of IT awards. Among those receiving awards in Business Information Systems in Ohio, 50% were women. This was only slightly below the national level of 54%. However, only 57% of those earning awards in Computer Teacher Education in Ohio were women compared to 66% of those nationally. The percentages of women receiving awards from Ohio schools in Graphic Arts/Publishing, Computer Information Science, and Computer Engineering were only slightly below national percentages. Ohio exceeded the nation in the percentage of Computer Technology Installation/Repair recipients who were women.

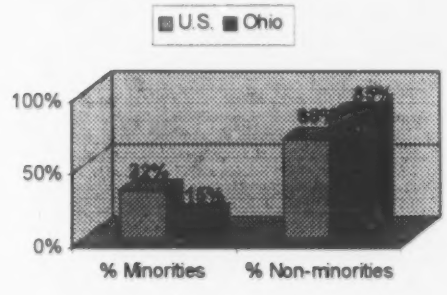
% Female Graduates by Nature of IT Award (5 year totals)



MINORITY DEGREE PRODUCTION IN IT FIELDS:

While a gender gap is evident, minority disparities are an even greater issue for the production of IT workers (i.e., African American, Latino, and Asian/Pacific Islander graduates). Nationally, IT awards to minorities in academic year 1995-96 totaled 103,682. Of these, 3,667 or 3.5% of workers were produced by Ohio. The disparity is more apparent in Ohio given that minorities accounted for 15% of the state's IT graduates compared to 32% of IT graduates nationwide.

IT Graduates by Race (All IT Clusters Combined 1995-96)



Interestingly, the disparity is greatest at lower levels of educational attainment in Ohio. For example, the percentage of minority

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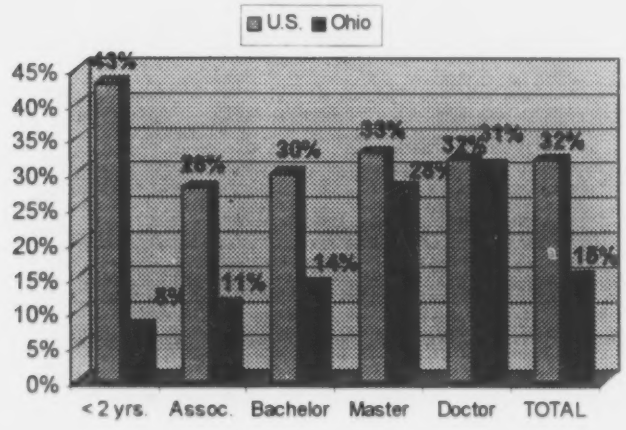
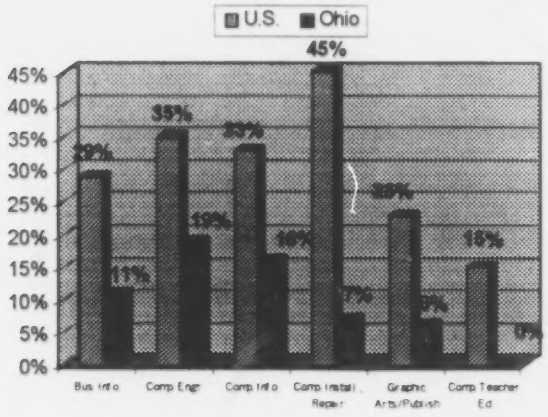
completions at the doctoral and Master's level in Ohio were similar to those of the nation. At the Associate's and Bachelor levels, however, Ohio experienced a considerably lower proportion of minority awards. In addition, while 43% of awards of less than two years were granted to minorities across the U.S., only 8% of Ohio awards at this level were granted to minority populations.

By nature of IT award, Computer Installation/Repair programs produced the highest proportion of minority graduates nationwide (45%), but represented the lowest proportion of minority graduates in Ohio (7%). Ohio's Computer Engineering programs produced the greatest share of minority graduates (19%), followed by Computer Information Science (16%), and Business Information Systems (16%).

% Minority Graduates by Level of Award (1995-96)



% Minority Graduates by Nature of IT Award (1995-96)



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INFORMATION TECHNOLOGY: AWARDS OF LESS THAN TWO YEARS
Ohio Compared to the U.S.

◆ KEY FINDINGS ◆

Awards of less than two years accounted for 8% of all IT awards in Ohio between 1991-96.

From 1991-96, Ohio produced less than 1% of the nation's IT awards of less than two years.

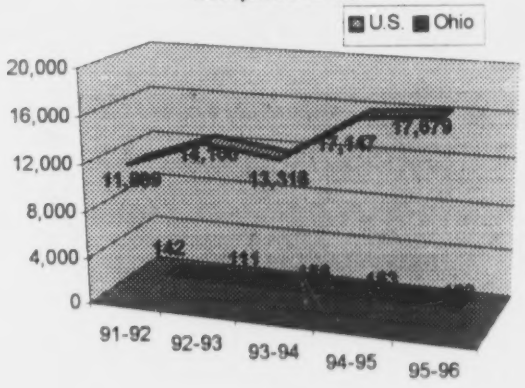
While awards at this level within the Computer Installation/Repair cluster nearly tripled over the five year period for the nation (+194%), Ohio experienced no growth in these less than two year awards.

Likewise, awards of less than two years in Computer Information Sciences increased nationally by 35% over the five year period but decreased in Ohio by 74%.

A higher proportion of women received less than two year awards in Ohio than in the nation.

Only 9% of less than two year awards were granted to minorities in Ohio compared to 37% nationally.

 # IT-Related Awards of Less Than Two Years Produced 1991-1996 in Ohio Compared to U.S.

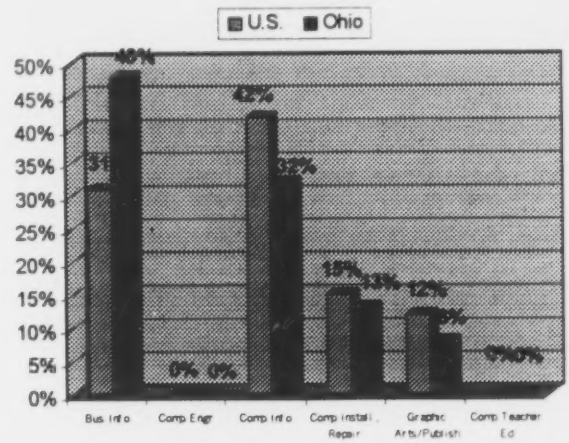


In Ohio, awards of less than two years accounted for 8% of all IT related awards from 1991 to 1996. During this period our state produced slightly less than 1% of the nation's IT related awards of less than two years. More important, the U.S. experienced a 50% increase in less than two year awards (from 11,809 in 1991 to 17,679 awards in 1996) while Ohio experienced a 13% decrease (from 142 in 1991 to 123 in 1996).

Growth in less than two year awards in Business Information Systems were similar for Ohio and the nation. On the other hand, while Ohio experienced no growth in Computer Installation and Repair awards at this level, awards in this program nationwide nearly tripled (+194%). Likewise, awards of less than two years in Computer Information Sciences increased nationally by 35% over the five year period but decreased in Ohio by 74%. Within the Graphic Arts/Publishing cluster, Ohio's 143% increase exceeded the 80% increase experienced across the U.S.

A comparison of Ohio and the U.S. also revealed differences in the proportional distribution of non-degree awards by IT cluster. For example, in Ohio proportionately more awards of less than two years were granted in Business Information Systems (48%). In the U.S., the greatest proportion of less than two year awards were granted in Computer Information Sciences (42%).

Nature of IT Awards of Less Than Two Years in Ohio Compared to U.S. (5 year totals.)



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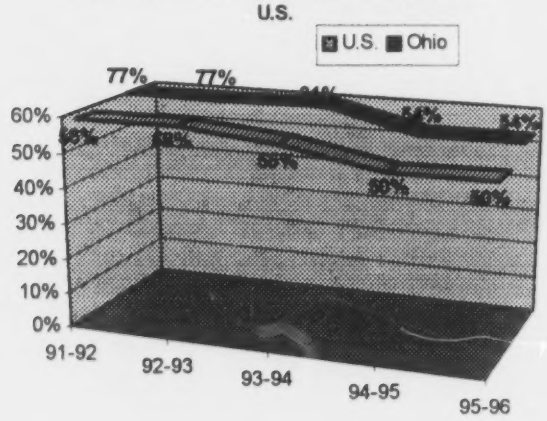
FEMALE AWARDS OF LESS THAN TWO YEARS IN IT FILEDS:

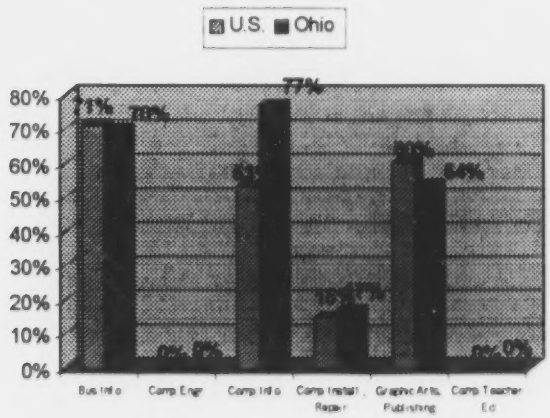
The examination of IT awards in all cluster areas between1991 and 1996 reveals that a higher proportion of women than men received awards of less than two years in Ohio (64%) than in the nation as a whole (54%).

% Female Awards of Less Than Two Years in All IT-Related Fields: Ohio Compared to U.S.



By IT cluster, Ohio exceeded the nation in the proportion of Computer Information Science awards of less than two years to women (77% and 53% respectively). Ohio lagged the nation, however, in the proportion of Graphic Arts/Publishing awards of less than two years to women (54% and 60% respectively).

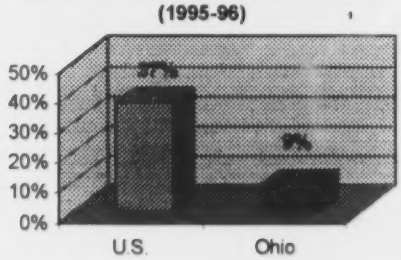
Percent Female Awards of Less Than Two Years: Ohio Compared to U.S. (5 year totals.)



MINORITY AWARDS OF LESS THAN TWO YEARS IN IT FIELDS:

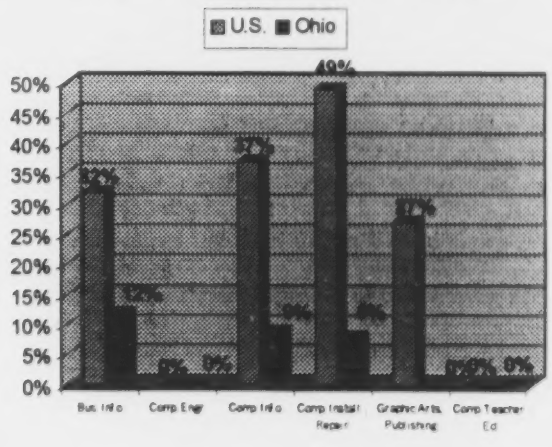
The disparity in less than two-year awards granted to minorities was much greater for Ohio than the U.S.

% Minority granted Less Than Two Year awards in All IT Related Fields (1995-96)



By IT cluster, Ohio lagged the nation in the proportion of less than two year awards granted to minorities.

Percent Minority Less Than Two Year Awards: Ohio Compared to U.S. (1995-96)



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INFORMATION TECHNOLOGY ASSOCIATE DEGREE PRODUCTION

Ohio Compared to the U.S.

◆ KEY FINDINGS ◆

On average, Associate Degrees accounted for 27% of all IT awards in Ohio between 1991-96.

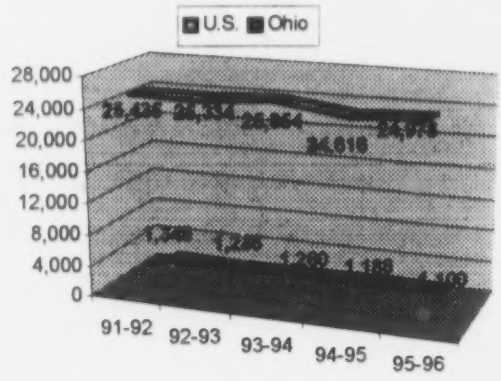
From 1991-1996, Ohio produced 5% of the nation's IT Associate degree graduates.

Ohio is attracting and graduating females from Associate degree programs in IT fields of study (about half).

The percentage of minorities achieving Associate Degrees in IT fields is weak in Ohio (11%) compared to the nation (28%).

In both Ohio and the U.S., most Associate degrees are granted in Computer Information Science and Business Information Systems. Ohio lags the nation in the proportion of Associate degrees awarded in Computer Installation/Repair and Graphic Arts/Publishing, two areas of high demand across the state.

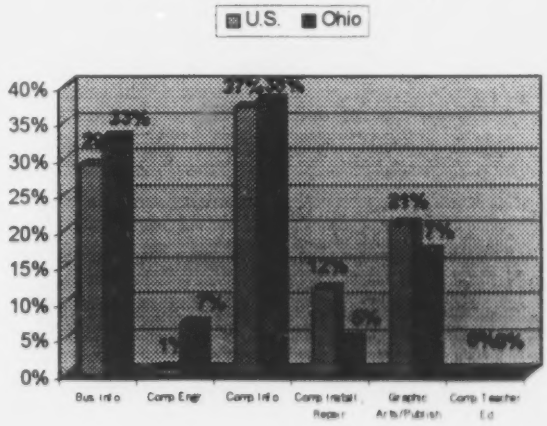
 # IT-Related Associate Degree Holders Produced 1991-1996 in Ohio Compared to U.S.



In Ohio, Associate degrees accounted for 27% of all IT awards. From 1991 to 1996, our state produced 5% of the nations IT related Associate Degree holders.

Over these five years, the number of IT Associate degree awards decreased for both Ohio and the U.S. The nation produced a total of 25,435 IT workers with two-year degrees in 1991 which was down to 24,078 by 1996. Similarly, Ohio produced 1,349 IT Associate Degree holders in 1991 and only 1,100 in 1996.

Nature of IT Associate Degrees in Ohio Compared to U.S. (5 year totals.)



Over the same five year period, on average, Ohio produced proportionately *fewer* Associate Degree holders in the IT-related clusters of Computer Installation/Repair and Graphic Arts/Publishing than did the rest of the nation. Ohio did, however, produce a slightly greater proportion of Computer Engineering Associate Degree graduates. Similar production in Business Information Systems and Computer Information Sciences were evident for Ohio and the U.S. at the two-year degree level.

Assuming a demand exists, areas of emphasis for EnterpriseOhio might be production of workers in both Installation/Repair and Graphic Arts, particularly since these two clusters are more common to the Associate degree level than are IT occupations which traditionally require four-year or advanced education like Computer Information Sciences and Computer Engineering.

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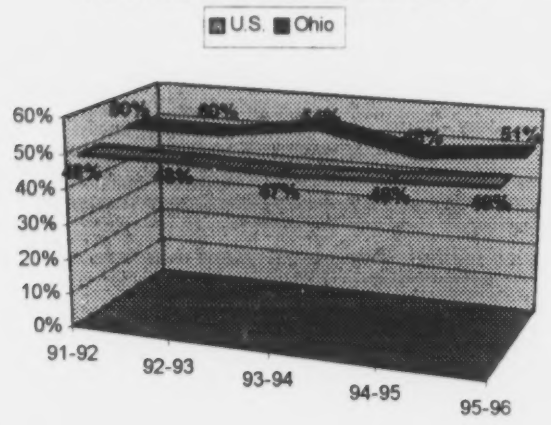
FEMALE ASSOCIATE DEGREE AWARDS IN IT FIELDS:

The percent of females achieving an Associates Degree in IT-related fields has been consistently steady and strong over the five year period for which data is available at comparable levels. In both Ohio and the nation, approximately half of all IT-related Associate Degrees were awarded to females.

% Female Associate Degree Holders in All IT-Related Fields: Ohio Compared to U.S.

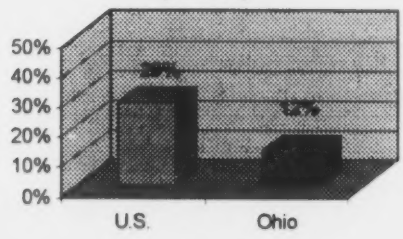


Ohio is, however, producing *fewer* female Associate Degree holders in areas of Computer Installation/Repair, Computer Information Sciences, and Graphic Arts/Publishing than is the U.S. Female Associate Degree production was slightly *higher* in Computer Engineering for Ohio.

MINORITY ASSOCIATE DEGREE AWARDS IN IT FIELDS:

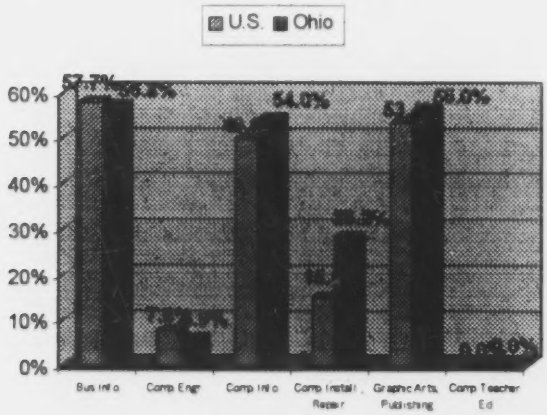
While production of female IT-related workers at the Associate Degree level is sufficient, the percentage of minorities achieving Associate degrees in IT clusters in Ohio is weak, particularly when compared to the nation. In 1995-96, only 11% of all Associate Degrees in IT-related fields were awarded to minorities compared with 28% across the nation. (Minority data tracking was initiated in1994-95 making five-year longitudinal analysis impossible with the exception of the Computer Information Sciences cluster. Data is therefore provided for the most recent year available, not a five year average).

% Minority Associate Degree Holders in All IT Related Fields (1995-96)

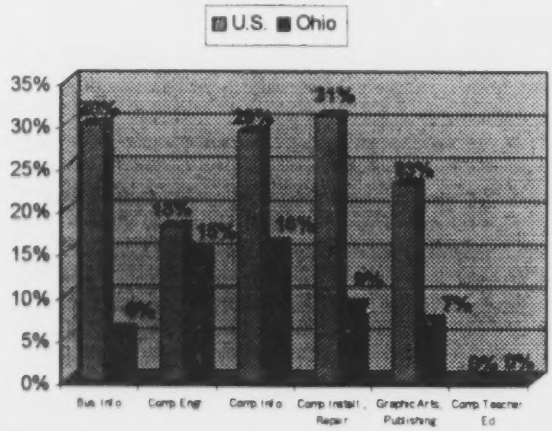


Associate Degree awards to minorities in IT-related fields were proportionately lower in all cluster areas for Ohio, but particularly in Business Information Systems and Computer Installation/Repair.

Percent Female Associate Degree Holders: Ohio Compared to U.S. (5 year totals.)



Percent Minority Associate Degree Holders: Ohio Compared to U.S. (1995-96)



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INFORMATION TECHNOLOGY BACHELOR DEGREE PRODUCTION
Ohio Compared to the U.S.

❖ KEY FINDINGS ❖

On average, Bachelor Degrees accounted for 52% of all IT awards in Ohio between 1991-96.

From 1991-1996, Ohio produced 42% of the nation's IT Bachelor Degree graduates.

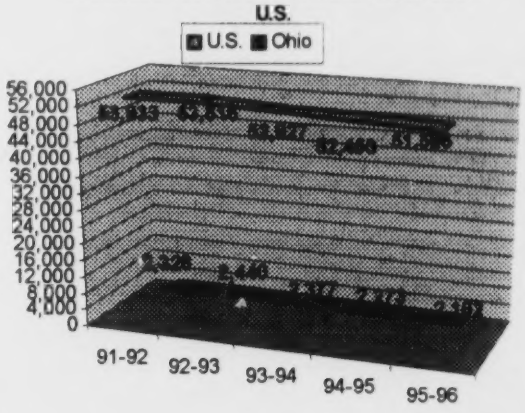
While half of all Associate degrees in IT fields are awarded to females, only one-quarter of IT Bachelor degrees are granted to women in both Ohio and the nation.

Like Associate degrees, the percentage of minorities earning Bachelor degrees in IT fields is weak in Ohio (14%) compared to the nation (30%).

In Ohio and the U.S., most Bachelor degrees are granted in Computer Information Science and Computer Engineering clusters.

Proportionately, Ohio produces more IT workers with Bachelor degrees in Business Information Systems than does the nation.

 # IT-Related Bachelor Degree Holders Produced 1991-1996 in Ohio Compared to U.S.



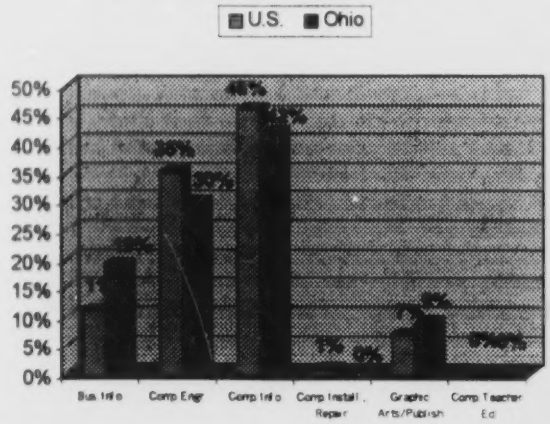
In academic year 1995-96 alone, Ohio produced 4.2% of the nation's IT-related Bachelor degree holder. A total of 264,725 IT-related Bachelor degrees were granted nationally between 1991 and 1996. Of these, 11,580 or 4.4% were granted in Ohio. Nationally, the number of IT-related Bachelor degrees decreased by 4%, from 53,953 in 1991 to 51,596 in 1996. This change was more pronounced in Ohio where IT-related Bachelor awards decreased by 7%, from 2,328 in 1991 to 2,162 in 1996.

Nationally, the greatest growth in Bachelor degree production over these five years occurred in the Computer Installation/Repair cluster. Actual numbers of awards in this cluster were relatively small although there was a marked increase beginning in 1994. NCES data reveal no Bachelor awards for the Computer Installation/Repair cluster in Ohio during this period. Ohio experienced the greatest growth in programs of Business Information Systems (5.5%), exceeding a national increase of 4.5%. A decline in Computer Engineering Bachelor awards in Ohio (-3%) was slightly lower than the U.S. (-4%).

The greatest decline in Ohio was in the cluster of Computer Teacher Education (-14%). Nationally production of these teachers remained stable over the same period. Ohio experienced more significant decreases in Graphic Arts/Publishing (-4% compared to -1% across the nation) and in Computer Information Sciences at the Bacceloriate level (-3% compared to -.3% nationally).

The relative proportions of IT-related Bachelor degrees awarded between 1991 and 1996 in Ohio were similar to that of the nation. The largest concentration of Bachelor degree holders both statewide and nationally were in the clusters of Computer Information Science, Computer Engineering, and Business Information Systems. However, compared to the U.S., Ohio produced proportionately fewer four-year graduates in all IT-related clusters except Business Information Systems.

Nature of IT Bachelor Degrees in Ohio Compared to U.S. (5 year total)



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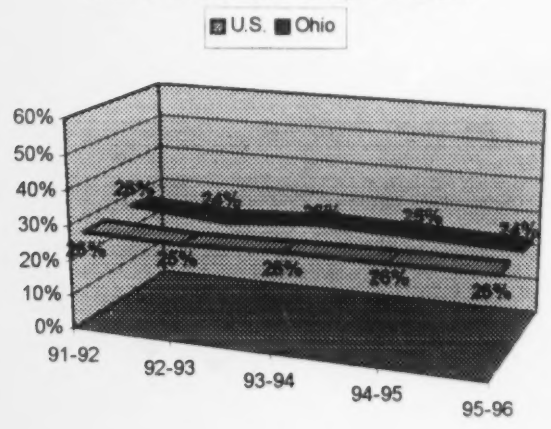
FEMALE BACHELOR DEGREE AWARDS IN IT FIELDS:

While half of all Associate degrees in IT are awarded to females, only one-quarter of IT-related Bachelor degrees are granted to women. While significantly lower levels of participation and achievement are apparent at the four-year level, the percentage of females achieving Bachelor degrees in IT-related fields was stable from 1991 to 1996 in both Ohio and the nation.

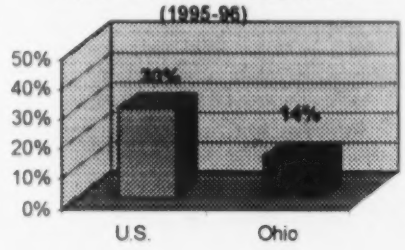
% Female Bachelor Degree Holders in All IT-Related Fields: Ohio Compared to U.S.



MINORITY BACHELOR DEGREE AWARDS IN IT FIELDS:

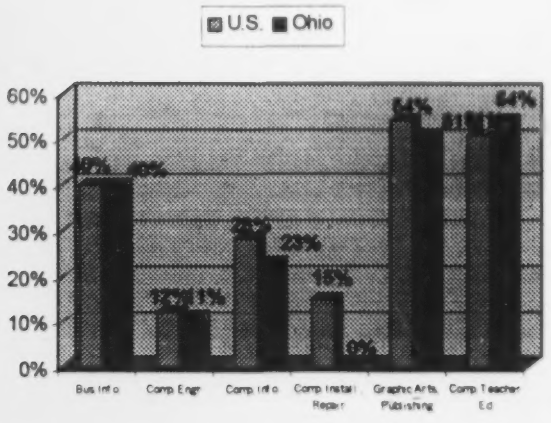
In 1995-96, only 14% of Bachelor degrees in IT fields were awarded to minorities in Ohio, compared to 30% across the nation. The disparity exists in all IT clusters for Ohio.

% Minority Bachelor Degree Holders in All IT Related Fields (1995-96)

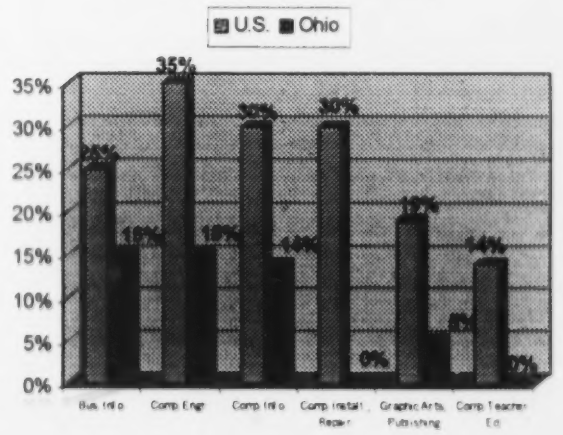


Ohio exceed the nation in the percentages of women completing Bachelor degrees in Computer Teacher Education. Ohio lagged the nation in the percentage of females earning Bachelor degrees in Computer Installation/Repair, Computer Information Science, Computer Engineering, and Graphic Arts/Publishing.

Percent Female Bachelor Degree Holders: Ohio Compared to U.S. (5 year total)



Percent Minority Bachelor Degree Holders: Ohio Compared to U.S. (1995-96)



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INFORMATION TECHNOLOGY ADVANCED DEGREE PRODUCTION (Master & Doctorate)
Ohio Compared to the U.S.

❖KEY FINDINGS ❖

Advanced degrees (Master and Doctorate) accounted for 18% of all IT awards in Ohio between 1991-96.

From 1991-96, Ohio produced X% of the nation's IT Advanced degree graduates.

Nationally, female IT awards have been lowest at the Advanced degree level (22%). In Ohio, the percentage of female IT workers earning Advanced degrees has been even lower (17%).

While not as great of a disparity as other award levels, the percentage of IT Advanced degrees awarded to minorities in Ohio during academic year 1995-96 (28%) was slightly below the nation (30%).

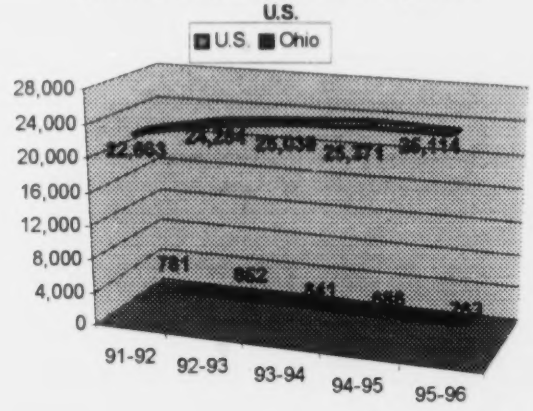
Most Advanced degrees in Ohio and the U.S. are awarded in the Computer Engineering and Computer Information Sciences clusters. Proportionately, Ohio produced more Advanced degree graduates in Computer Engineering.

In 1995-96, Ohio produced 3% of the nation's IT advanced degree holders. A total of 122,441 Master's and Doctor's degrees were awarded nationally between 1991 and 1996. Of these, 3,925 were granted in Ohio. During this period, the number of IT advanced degrees increased nationally by 11%, from 22,663 in 1991 to 25,114 in 1996. Ohio, however, experienced a decrease of -2%, from 781 in 1991 to 763 in 1996.

Nationally, the Business Information Systems cluster produced greatest proportion of graduates (71%). Growth for this cluster in Ohio was considerably lower at 27%. Growth in advanced degree production in our state was greatest in the Graphic Arts/Publishing cluster (67%). Ohio experienced no growth in advanced degree awards for the clusters of Computer Teacher Education and Computer Installation/Repair. While advanced degree production in Computer Engineering grew by 4%, Ohio experienced a decline of -8% in this cluster.

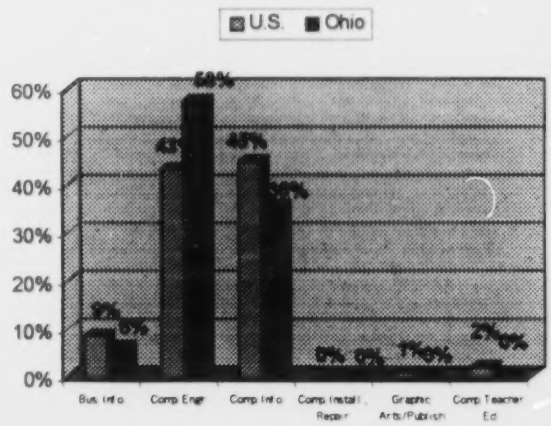
Despite a decline in the number of advanced degrees awarded in Computer Engineering between 1991-96, Ohio exceeded the U.S. in the proportion of advanced degrees awarded in this cluster. Conversely, a smaller proportion of Ohio's advanced degrees (36%)

 # IT-Related Advanced Degree Holders Produced 1991-1996 in Ohio Compared to U.S.



were awarded in Computer Information Sciences compared to the U.S. (45%). Smaller proportions of advanced degrees were also awarded in Ohio in the Graphic Arts/Publishing, Business Information Systems, and Computer Teacher Education.

Nature of IT Advanced Degrees in Ohio Compared to U.S. (5 year total)



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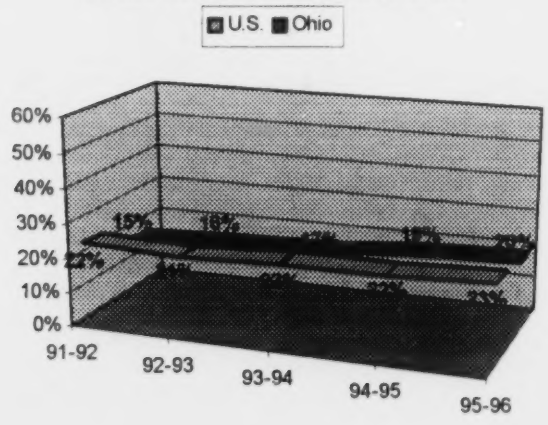
FEMALE ADVANCED DEGREE AWARDS IN IT FIELDS:

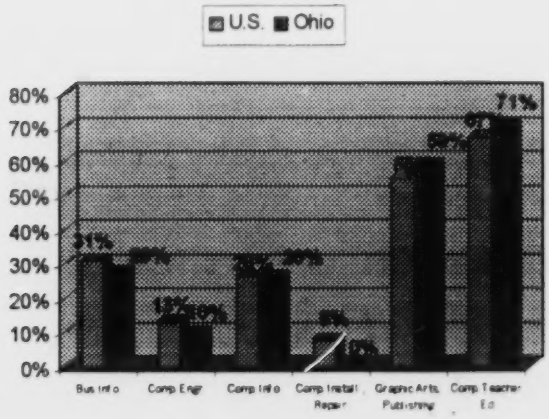
Nationally, female IT awards have been lowest at the advanced degree level (i.e., has been half of all Associate awards, one-quarter of all Bachelor awards, but only 22% of all advanced degree awards). In Ohio, the percentage of female IT workers holding advanced degrees has been even lower than that of the nation. On average, only 17% of all IT Master and Doctorate degrees combined were granted to females over the five year period. Although consistently below national levels, Ohio has made progress in this area as the percentages of females achieving advanced degrees increased from 15% in 1991 to 20% in 1996.

% Female Advanced Degree Holders in All IT-Related Fields: Ohio Compared to U.S.



The relative proportions of females earning advanced IT degrees in Ohio mirrored the nation. For example, in both Ohio and the U.S., female advanced degrees were proportionately highest in the clusters of Computer Teacher Education and Graphic Arts/Publishing. Ohio did, however, exceed national levels in both cases. The percentage of females earning advanced degrees in Computer Installation/Repair areas were the lowest among IT fields of study, both in Ohio and nationally. Ohio lagged the nation in advanced degree achievement among females in Computer Engineering and Business Information Systems.

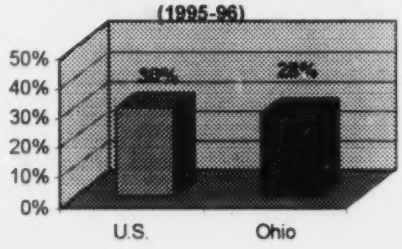
Percent Female Advanced Degree Holders: Ohio Compared to U.S. (5 year total)



MINORITY ADVANCED DEGREE AWARDS IN IT FIELDS:

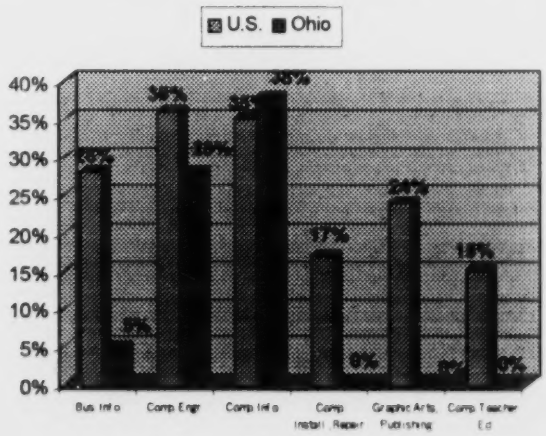
While not as great of a disparity as other award levels, the percentage of IT-related advanced degrees awarded to minorities in Ohio during academic year 1995-96 (28%) was slightly below the nation (30%)

% Minority Advanced Degree Holders in All IT Related Fields (1995-96)



In the same year, Ohio's advanced degree awards to minorities were proportionately lower in all cluster areas except Computer Information Science.

Percent Minority Advanced Degree Holders: Ohio Compared to U.S. (1995-96)



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SERVICE DELIVERY OPPORTUNITIES

FOR THE EnterpriseOhio Network

QUANTITY OF IT WORKERS

QUALITY OF IT WORKERS

EMPLOYERS GROW THEIR OWN IT WORKERS

RAISING TECHNOLOGICAL ABILITIES OF OHIO'S INCUMBENT WORKFORCE

SERVICE DELIVERY OPPORTUNITIES

Strategic Intent	Related Market Need	Strategic Response
Improve the Quantity of IT workers to satisfy employer hiring demands in the state of Ohio	1a. Lack of consistent framework and common language regarding the nature of IT work and employer needs/demands. Related need to enhance awareness and better inform Ohioans of IT related career opportunities.	Implement an aggressive education and recruitment campaign to attract more Ohioans to IT careers and EON.
	1b. Produce more workers in the IT clusters of Computer Support, Maintenance, Repair; Network Technology, and Digital Media Technology given the hiring demands of Ohio employers.	Subsidize on-line IT education and training programs to improve the quantity of IT workers in Ohio. Focus distance learning programming on Computer Support, Maintenance, Repair; Network Technology, and Digital Media Technology.
	1c. Increase the quantity of distance learning programs across EON to improve access to IT programs for all Ohioans.	
	1d. Explicit need to improve access to IT education and training programs for minorities and the reduce the disparity in educational awards granted to these populations of Ohio.	Invest in scholarship funds for minority populations to attract and produce a more ethnically balanced population of IT workers in Ohio and to raise the educational attainment and income levels of these populations.
	1e. Better connect EON IT students/graduates and employers to enhance recruitment/hiring smart among Ohio employers.	Strengthen the ability of EON to provide employment services at various levels for IT job seekers and employer-customers.
	1f. Produce more workers in the IT clusters of Systems Development/Integration; Software Development/Engineering, and Database Administration to assist Ohio with attraction and retention of IT firms and IT enabled large employers.	Offer tuition assistance and other incentives for students/graduates of two-year IT programs to pursue further education and training in areas of IT specialty which require more advanced training. Strengthen articulation agreements and related partnerships with Ohio universities.
Improve the Quality of IT and IT-enabled workers in the state of Ohio	11a. Incorporate all three strands of IT skill requirements into EON IT education & training programs. Assure employers of necessary skill acquisition on behalf of EON IT graduates.	Adopt skill standards for the EON and implement a quality assurance plan to ensure alignment of curriculum and student learning outcomes with industry needs and demands.
		Create and establish validation centers across EON to assess IT skill acquisition among learners/graduate, including soft skill acquisition.
		Establish an employer, no-cost guarantee in Ohio that all EON IT graduates who are perceived skill deficient will be provided additional training at no expense.
	11b. Inability and expressed need for IT workers to relate IT work to business processes and applications.	Increase work-based learning requirements among EON IT programs. Offer incentives to employers to increase participation in applied learning of IT students.
	11c. Improve the quality of IT teaching and instructional staff among EON campuses.	Offer incentives for EON IT faculty to participate in teacher externships. Provide incentives to employers to encourage their participation.
	11d. Need to integrate IT learning across academic disciplines to produce an IT-enabled workforce across industry/occupations in Ohio.	Establish standards for basic technology learning and align all areas of EON education/training programs.

Help Ohio employers grow their own IT workers	111a. Employers interest in growing their own IT workers given recruitment costs and need to customize IT work to business processes and applications. Post-hire training also perceived as more effective than pre-hire methods by employers.	Promote through an aggressive marketing campaign the EON as the primary contracted training resource for "growing IT workers". Adopt a battery of assessment tools, techniques and processes to identify incumbent workers with strongest potential for career advancement into IT fields. Pilot a skill matching system for growing IT workers out of existing employees. Develop training modules by IT function. Guarantee college credits for incumbent worker IT training.
Help raise the technological abilities of Ohio's incumbent workforce	Iva. Greatest IT struggle for Ohio employers is ongoing development of an IT-enabled workforce which can support technology integration and participation in the digital economy. Related is the need to tailor incumbent worker training to industry specific work.	Adopt a batter of assessment tools specific to job clusters which can adequately assess technology related skills required for successful job performance. Develop short, intense training modules. Develop strategies for increased flexibility in academic credit for short term training. Establish an EON "Help Desk" or "Warm Line" (both telephone and online) to help workers with PC maintenance and application needs as recommended by Ohio employers.

THE EnterpriseOhio NETWORK:

A PRIMARY IT RESOURCE FOR THE STATE OF OHIO

ANALYSIS FRAMEWORK

PRODUCTION OF IT WORKERS

RAISING TECHNOLOGICAL COMPETENCIES OF OHIO'S INCUMBENT WORKFORCE

ATTRACTING OHIOANS TO IT CAREERS

INTEGRATION OF IT LEARNING ACROSS ACADEMIC DISCIPLINES

MODEL CURRICULA & SKILL STANDARDS TO INFORM EON IT PROGRAMS

INVESTMENTS IN IT FACULTY

IMPROVING TECHNOLOGY ACCESS

PARTNERSHIPS TO ENHANCE THE SUPPLY OF IT WORKERS

KEEPING PACE WITH TECHNOLOGY

IT CAPACITY OF THE EnterpriseOhio NETWORK: ANALYSIS FRAMEWORK

The Joint Center for Policy Research designed and administered a capacity inventory to assess the current and planned responses to IT market demands among the two year campuses of the EnterpriseOhio Network. In designing the inventory, market research findings were used to conceptualize eight dimensions of IT leadership. The capacity of EON was then measured relative to each of these dimensions.

Findings of the capacity inventory are being used by the EnterpriseOhio Network for:

- Business Development
- Marketing/Promotion
- Internal Capacity Building

Findings of this project will be used for business development, or new and expanded service delivery for IT job seekers and for existing/prospective Ohio employers utilizing the resources of the EnterpriseOhio Network. Translating action research findings into educational literature to better inform Ohioans of IT career opportunities, attract more Ohioans into IT careers, and produce a stronger supply of IT workers for Ohio will consume marketing and promotional efforts of the Network. Employers and incumbent workers will also be targeted for marketing/promotion efforts given the capacity and track record of two-year campuses in providing contracted services to these audiences. Where gaps in service delivery are apparent, the EnterpriseOhio Network will also embark on internal capacity building to strengthen service delivery for Ohioans and employer-customers. Overall, the business development, marketing/promotion, and internal capacity building is intended to strengthen economic competitiveness within Ohio, particularly since workforce development is key to retention, attraction, and global productivity among employers.

DIMENSIONS OF IT LEADERSHIP

I. Increasing the supply of IT workers consistent with needs/demands of Ohio employers.

II. Raising technological competencies of Ohio's incumbent workforce.

III. Targeted marketing and recruitment to attract minorities and other populations into IT careers.

IV. Integration of IT learning across academic disciplines.

V. Use of model curricula and skill standards to inform development and modification of EON IT programs and ensure compatibility with industry needs.

VI. Investments in IT faculty for quality production of IT workers.

VII. Improving technology access for all Ohioans.

VIII. Public-private partnerships to enhance the supply of IT workers in Ohio.

EnterpriseOhio Network: PRODUCTION OF IT WORKERS

Marketing/Promotion:
More than 164 IT degree programs and 132 certificate programs are available to Ohioans through the EnterpriseOhio Network.

Nearly 17,000 Ohioans were enrolled in EON IT degree or certificate programs in academic year1998/99 alone.

EON is solid resource for the production of Systems Development & Integration workers, which based on market research is an area of high demand for IT firms and IT-enabled large firms. Production of these IT workers will contribute to Ohio's ability to attract and retain IT firms, an area where our state currently lags other portions of the U.S. in the transformation to a new economy.

Business Development:
To better serve the human resource needs of IT firms and IT-enabled large firms, opportunity exists to increase the number of IT programs (and enrollment) in areas of Software Development/Engineering and Information Systems Management.

While often integrated into the course work of other types of IT degree/certificate programs, EON currently offers only a few degree/certificate programs in Database Management & Warehousing, an area of IT-related work that is re-emerging in Ohio and across the nation.

Given the enormous need for all IT workers to be technical translators, opportunity exists within the EON to expand degree/certificate programs in Technical Communication Technology, currently offered only by Columbus State and Cincinnati State Community Colleges in Ohio. Integration of this kind of course work into other IT programs would also greatly benefit IT learners and Ohio employers.

Internal Capacity Building:
Given the need for Computer Support, Maintenance, Repair personnel and Network Technology Specialists across all types and sizes of companies in Ohio and the U.S., special effort should be made to increase enrollment within these programs to produce a larger supply of IT workers in these areas of specialty.

All IT degree and certificate programs were identified by the 44 two-year campuses responding to the capacity inventory. Once identified, each program was carefully reviewed and coded by type of IT related area of work. The same framework used to assess demand for IT workers was used to classify IT degree and certificate programs. In addition, campuses were asked to provide the total student enrollment and total number of graduates from each program in the last full academic year (i.e., 1998/99). The overall intent was to compare current responses of the EnterpriseOhio Network with needs and demands of Ohio employers.

➡ ***EON is a proven resource for the production of IT workers in the state of Ohio.***

- More than 164 IT degree programs and 132 certificate programs are available to Ohioans through the EnterpriseOhio Network.
- EON IT education/training programs are offered in all areas of demand by Ohio employers. Ohioans can access training in Computer Support/Maintenance/Repair, Network Technology, Digital Media Technology, Systems Integration, Database Management/Warehousing, Software Development/Engineering, Technical Communication Technology, Information Systems Management, Manufacturing Engineering Technologies, and Office/Business Management Technology.
- Nearly 17,000 Ohioans were enrolled in EON IT degree or certificate programs in academic year1998/99 alone.

NATURE OF IT DEGREE OFFERINGS/ENROLLMENT BY EON:

Market research reveals that Ohio employers of all sizes and types are in need of Computer Support/Maintenance/Repair workers, Network specialists, and Digital Media specialists. The greatest demand for Systems Development/Integration, Software Development/Engineering, and Information Systems Management workers, however, comes primarily from IT firms and large IT-enabled firms (primarily corporate headquarters and large employers with sizeable IT departments). Database Management and Warehousing appears to be a re-emerging need for many employers given mandated reporting requirements and increased use data for planning and decision making.

Proportionately, the greatest share of IT *degree* programs available through EON are in Systems Development/Integration (22% of all IT degree programs). Programs in Systems Development & Integration prepare individuals primarily as Systems

processes. These offerings also constitute 22% of all EON IT certificate programs. A total of 7,590 Ohioans or 48% of all EON IT enrollment in1998/99 was in this area of IT related education/training at the degree level. *This means the two-year campuses are strong resource for IT firms and large IT enabled companies given their demand for Systems Development and Integration workers. This is particularly important for the creation and attraction of more technology firms to Ohio, an area where our state reportedly lags "star" technology areas of the United States.*

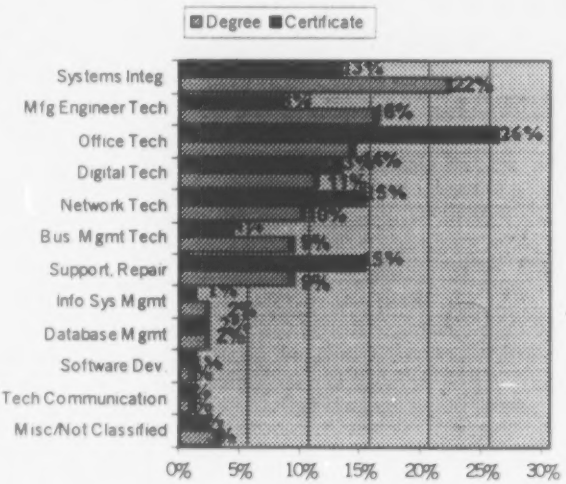
In addition to Systems Development and Integration, the second largest share of IT-related programs and IT enrollment is in Manufacturing Engineering Technologies. Given the manufacturing base of Ohio and the impact technology is having on this particular industry, the two-year system of Ohio continues to have a strong impact on the production of manufacturing workers with strong technical skills in Computer Aided Drafting & Design and in Electrical/Electronic fields. Sixteen percent of all IT degree programs are in manufacturing engineering technologies and in 1998/99 nearly 1,800 Ohioans were enrolled in these degree and certificate programs.

Digital Media Technology is an area of demand in Ohio as employers move forward with Web Site development and E-commerce applications. Currently, 11% of all IT degree programs offered by EON are in Digital Media Technology. These programs prepare individuals to use technological tools and applications to put text and graphics into appealing documentation and presentation formats. Programs range from specific training in Computer Art, Computer Graphics, and Audio/Video Production to broader based training in Digital Media Technology. Also included in this career track are education/training programs in Web Design and Development. There is little consistency across EON in relation to academic divisions offering these programs. Curriculum tends to vary based on the nature of the academic division with the offering. In 1998/99 alone, more than 800 Ohioans were enrolled in these two-year degree programs.

There is no doubt that Computer Support, Maintenance, and Repair personnel are in great demand nationally and locally. Related EON programs constitute 9% of all IT degree offerings and 15% of all certificate programs. These programs are intended to produce IT workers who engage in the delivery, installation, operation, maintenance, and repair of information technology artifacts. They prepare students to understand the design of PC systems including hardware and software needed to run personal computers, minicomputers, and networked computers. Most EON programs prepare learners for the industry standards A+ Certification test. They are most often integrated into the more traditional electronics/electrical engineering programs of the two-year campuses. Program terminology ranges from Computer Systems Support, Software Support, to Electronics Engineering with Computer Maintenance/Repair Option, Computer Technician, and PC Support or Administration. In 1998/99 a total 1424 individuals were enrolled in these degree programs and an additional 207 Ohioans in related certificate programs. Given the sizeable demand in Ohio and the U.S., EON campuses should strive to increase enrollment in these programs to produce a larger supply of workers.

Network technology, also an area of high demand for all employers, constitutes 4% of all EON IT degree programs and 15% of all certificate programs. These programs prepare IT workers to utilize the latest technologies for network design, administration, operation, maintenance, analysis and applications to business processes. Some programs build upon the computer support, maintenance, repair programs with specialty in networking. Some are taught from a business perspective with curriculum in management principles, accounting, database processing, and basic computer programming. Others are taught from a more technical electronics engineering perspective. Some programs are also tailored specifically to the telecommunications industry. In 1998/99, more than 850 Ohioans were enrolled in Network Technology degree programs. Like Computer Support, EON campuses should strive to increase enrollment in these programs to produce a larger supply of Network Specialists for Ohio.

Nature of EON IT Degree & Certificate Programs (1998/99)



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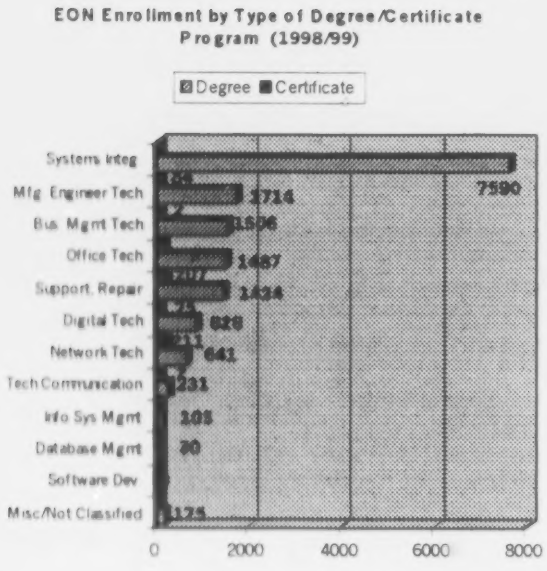

Fewer IT degree and certificate programs are offered by EON campuses in Information Systems Management, Database Management/Warehousing, Software Development, and Technical Communication Technology. While not a part of the IT related framework of work, Information Systems Management programs were classified separately from other EON programs because they prepare IT workers across a spectrum of IT applications. Generally individuals are trained to provide operational support for a wide variety of information systems, to identify and solve system problems, and to monitor and analyze system performances. These individuals also learn how to plan and prioritize work flow. They are programs that were difficult to classify under microcomputing technology, networking technology, digital media technology, database management/warehousing, or systems development and integration because they incorporate heavy course work in all of these areas. IMS programs constitute 2% of all EON IT degree programs while no certificate programs were apparent (more than likely because the breadth and depth of these programs are not conducive to anything less than a two-year degree). A total of 105 Ohioans were enrolled in these programs in 1998/99.

Database Management/Warehousing represents an opportunity for expanded service delivery among EON campuses. While it is a re-emerging area of demand, few programs are currently available (i.e., they constitute only 2% of all degree programs and 2% of all certificate programs offered by the Network and only 60 individuals were enrolled in 1998/99). These programs prepare IT workers in conceptual logic data modeling and physical design, database implementation, maintenance, and support. Instruction is provided on the design of storage and retrieval systems for raw data in accordance with business use and applications. In addition to database creation, individuals learn how to modify databases, update databases, and extract data for reporting/presentation purposes. Back-up/recovery strategies, troubleshooting, and security maintenance are also common applications for these programs. While program offerings are limited, more often database administration is integrated into other IT education/training programs.

Software Development and Engineering is yet another area of IT related work which is in demand primarily among IT firms and IT enabled large employers. These programs prepare individuals to apply general engineering principles and methodologies to software development. They currently constitute only 1% of all EON IT degree programs. In 1998/99, enrollment was minimal.

Technical Communication Technology programs prepare individuals to communicate information of a technical nature to different audiences. Individuals prepared in technical communication can translate or write, edit, perform page layout/design on user manuals, text books, training materials, press releases, memos, computer-based training modules, prepare multi media presentations and develop material for delivery on CD -ROM. Technical communicators can discuss projects with technical experts and translate information so that any target audience can understand. While market research suggests that this is a primary skill requirement for any IT worker, there are only two programs of this nature with the EON. An opportunity exists to expand these degree/certificate programs and to integrate related course work into other IT programs.

Office/Microcomputing Technology and Business Management Technology, like Information Systems Management are also not a part of the IT related framework used to assess labor demand. These programs have been included as part of the EON education and training offerings given their high concentration in IT tools/applications. These two areas of programming are a strength for EON, constituting23% of all degree programs and 30% of all certificate programs. These education/training programs help prepare IT-enabled workers or individuals interested in learning how to use a personal computer for a variety of applications. Training usually focuses on general keyboarding skills, use of PC operating systems, and word processing, spreadsheet applications, desktop publishing, and fundamentals of exploring and finding information on the Internet. They may also include introductory course work on PC design, installation, maintenance, and repair but not with the same depth as computer support programs. Business management technology programs are geared for individuals with some workplace experience and desire to move into managerial/supervisory positions or those in management positions seeking to upgrade their computer skills. These programs emphasize electronic accounting, finance, economics, technical writing, etc., which are distinguishing features from Office/Microcomputing technology programs. In 1998/99 a total of 1,487 Ohioans were enrolled in Office/Microcomputing degree programs and a total of 1,506 in Business Management Technology programs.

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EnterpriseOhio Network: RAISING THE TECHNOLOGICAL COMPETENCIES OF OHIO'S INCUMBENT WORKFORCE

◆ KEY FINDINGS ◆

Marketing/Promotion:
More than 134 non-credit IT offerings are available to Ohioans through the EnterpriseOhio Network.

Unlike IT degree and certificate programs (geared toward the production of workers with IT specialty), EON non-credit offerings target technology end users or those who integrate technological applications into their work and the workplace. The primary focus is "micro-computing" applications like keyboarding, use of PC operating systems, word processing, spreadsheet and database development, desktop publishing, and fundamentals of exploring and finding information on the Internet.

Nearly 8,000 Ohioans attended EON non-credit IT courses/seminars in1998/99.

In the same year, EON served more than 460 employers with contracted IT training services helping to raise the technological competencies of nearly 20,000 workers in the state of Ohio.

Business Development:
Currently no non-credit courses/seminars are offered in Technical Communication and Database Management - both areas that could be conducive to short-term training applications.

Because Ohio employers of all sizes and types discussed raising the technological competencies of existing workers as their greatest IT struggle, the two-year campuses of Ohio were asked to describe the extent and nature of non-credit IT training offerings for individuals in need of strengthening their IT skills without pursuing a formal degree or certificate. The two year campuses were also asked to describe the extent and nature of contracted IT training services provided to employers and their existing workers. Like degree and certificate programs, enrollment in non-credit training programs were identified while the total number of employers and workers served were also estimated for fiscal year 1998/99. The overall intent was to determine the extent to which EON is helping to produce an IT-enabled workforce, an apparent area of critical demand for employer-customers.

EON is a primary resource for the production of an IT enabled workforce in Ohio offering short term, non-credit offerings and contracted training services to employers and their incumbent workers.

- More than 134 non-credit IT offerings are available to Ohioans through the EnterpriseOhio Network.
- Unlike IT degree and certificate programs (geared toward the production of workers with IT specialty), EON non-credit offerings target technology end users or those who integrate technological applications into their work and the workplace. The primary focus is "micro-computing" applications like keyboarding, use of PC operating systems, word processing, spreadsheet and database development, desktop publishing, and fundamentals of exploring and finding information on the Internet - all areas of skill development necessary for successful job performance in all types of industries and occupations.
- Nearly 8,000 Ohioans attended EON non-credit IT courses/seminars in1998/99.
- In the same year, EON served more than 460 employers with contracted IT training services reaching nearly 20,000 workers in the state of Ohio.

SHORT-TERM IT TRAINING OFFERINGS (NON-CREDIT):

Two-thirds of all non-credit offerings available to Ohioans are in areas of Office Systems and Microcomputer Technology. This is not surprising given that the primary emphasis of these short-term offerings is to enhance use of personal computers for business functions. Ohioans can choose from an array of courses/seminars in keyboarding, use of PC operating systems, word processing, spreadsheet and database development, desktop publishing, and presentation applications. EON places heavy emphasis on Microsoft Office applications like Word, Excel, Access, Power Point, Project Management, Desktop Publishing.

The second largest share of non-credit offerings are in Digital Media Technology. This primarily relates to basic training in areas like fundamentals of exploring and finding information on the Internet or short intense programs in web page design.

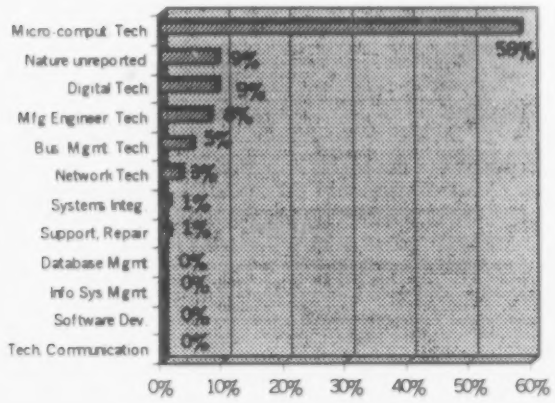
In addition to Micro-computing and Digital Media Technology, some non-credit training is available in Business Management Technology. These courses tend to emphasize instruction in electronic accounting, finance, marketing, economics, business statistics, business law and technical writing - which are distinguishing features from Office/Micro-computing Technology.

A few campuses reported short term offerings in Networking Technology, Systems Development and Integration, and Computer

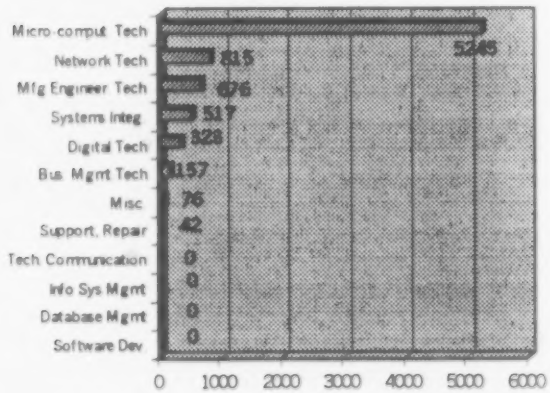
Support/Maintenance/Repair but no short term courses are available in Database Management/Warehousing, Technical Communication Technology, Software Development & Engineering, and Information Systems Management. Most of these areas of IT specialty require more lengthy training, but opportunity may exist within EON to develop courses/seminars in Technical Communication and Database Management/Warehousing. The geographic analysis revealed that non-credit IT offerings are available to Ohioans in all economic development regions of the state.

A total 7,851 individuals took advantage of non-credit IT offerings through EON in 1998/99 alone. A majority of students (5,245) were enrolled in micro-computing related courses. Another 815 individuals were enrolled in networking courses, 517 in systems integration courses (primarily training in specific programming languages), and another 323 in digital technology related courses.

Nature of EON IT Non-Credit Offerings



Enrollment in IT Non-Credit Training (1998/99) N=7851

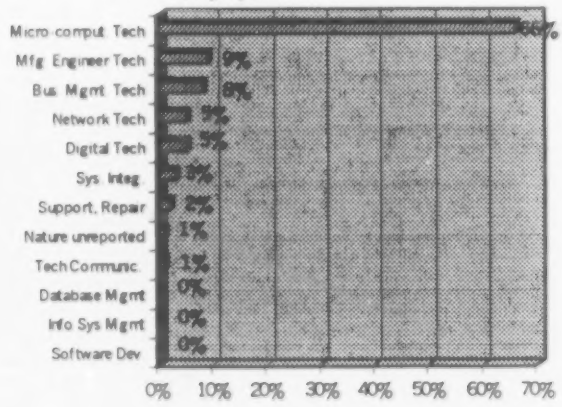


CONTRACTED IT TRAINING FOR EMPLOYERS/INCUMBENT WORKERS:

Like non-credit offerings, most contracted training for incumbent workers are offered in areas like Office/Micro-computing Technology and Business Management Technology. Manufacturing Engineering Technologies are also a primary emphasis of contracted training for employers and their existing labor force. It appears as if fewer employers/incumbent workers in economic development regions 2, 4, 5, 6, and 12 are served through contracted IT training services. This is somewhat surprising given that Toledo, Dayton, Cincinnati, and Youngstown - or some of the more urban areas of the state are among these regions. However, it might be that contracted IT services have been provided but campuses serving these areas had a difficult time tracking and reporting related numbers.

According the EON campuses, a total of 460 employers were provided customized training in IT related fields in 1998/99 alone. Through these employers, a total of 19,529 workers were provided the opportunity to upgrade their technological abilities through EON.

Nature of Contracted IT Training for Employers/Workers



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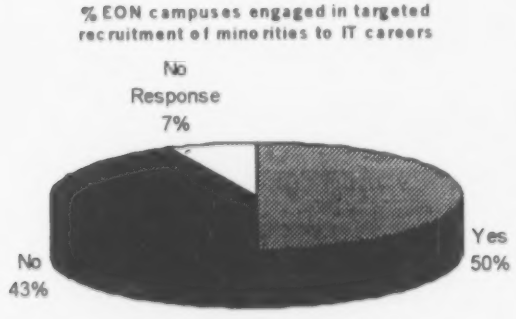
EnterpriseOhio Network: ATTRACTING OHIOAN's TO IT CAREERS

◆ KEY FINDINGS ◆

Internal Capacity Building:
Targeted marketing and recruitment of minorities and other special populations should be enhanced by EON campuses to decrease the disparity in minority IT graduates and help to close the gap in IT shortages.

While engaged in some targeted recruitment, no EON campus identified special incentive programs such as minority scholarships specifically geared for IT fields of study.

The longitudinal analysis of supply in Ohio compared to the U.S. revealed that historically, there been a significant disparity in the production of minority graduates from IT programs. The data analysis also revealed that the disparity has been greater for Ohio than the nation overall. In addition, there is quite a bit of literature that suggests if minorities and other special populations were specifically recruited for IT careers, labor shortages could be greatly minimized. As a result, the two year campuses were asked if they have engaged in any targeted marketing and recruitment efforts to attract students including minorities and economically disadvantaged into IT careers.



When asked to describe their efforts to attract minorities and the economically disadvantaged into IT programs, most campuses described general, as opposed to targeted recruitment efforts. These comments included references to "campus visits," "high school recruitment," "general recruitment activities," "virtual campus tours," and "high school career days". A few campuses also cited minority recruitment as tied to Tech Prep and School-to-Work efforts. Hocking College reported that "most students in our region are economically disadvantaged so we do not specifically target them as a group when marketing." Edison Community College, on the other hand, reported that its service delivery area is comprised of a "small minority population." Kent State University Tuscarawas reported that all 8th graders and high school seniors are invited to campus for a visit that "includes viewing high tech multimedia presentation about the Engineering Technology program." Similarly, Kent State University at Geauga is "planning to do a career seminar in October with emphasis on computers." Miami University Middletown reported that it "hosts a high school career day which includes technology contests, demonstrations, career presentations and also sponsors radio and tv ads for technical degrees including computer technology."

In commenting on targeted recruitment activities, some campuses referenced partnerships with welfare-to-work and other social service initiatives. For example, Southern State Community College reported on its 'partnerships with local social service agencies to provide computer training." The University of Akron described its 'partnership with Summit County Job and Family Services" and efforts to "provide short-term computer skills training to get individuals into IT careers." Similarly, Rio Grande Community College reported on its "Cross Roads" program in which "low income, hard-core unemployed are provided training in office technology and computer applications." Central Ohio Technical College reported that it conducts minority recruitment through "on-campus Job Prep Resource Center, the Department of Human Services, and other non-profit organizations."

Some institutions described minority recruitment efforts that were not IT-specific. For example, The University of Cincinnati stated that it has "a minority recruitment office on campus." Raymond Walters College reported that it does "target these populations but not specifically for IT careers." Miami University Middletown reported that it "routinely hosts a Minority Family Day." Stark State College of Technology referred to a program entitled "Women in Engineering" while Sinclair Community College cited the "Sinclair Chapter of Black Data Processing Professionals."

Examples of minority-specific IT recruitment were reported by Lorain County Community College, the Miami University branch campuses and by Cuyahoga Community College. Lorain County Community College reported "having an LCCC representative at two urban high schools on a weekly basis (with) presentations to math, science, and computer science classes."

Likewise the Business Technology program is a part of promotional efforts to attract students who are often under-represented in IT careers by each of the two Miami University regional campuses. In addition to television, radio, and newspaper advertisements, both campuses also publish promotional literature in Spanish which are sent to prospective, targeted students expressing interest in Miami's regional campuses. Also, part-time minority faculty are specifically targeted in advertising and promotional literature, in addition to the personal efforts to recruit adjunct faculty conducted by the chair and members of the Business Technology Department."

Cuyahoga Community College reported that the college serves a diverse mix of ages, race/ethnicity, gender, and employment status. Welfare-To-Work participants, displaced homemakers, and dislocated workers are served by open enrollment, and by grant-funded and customized programs. Minority enrollment has increased, in part due to targeted recruitment campaigns through their Technical Training Academies. Partnership with National City Corporation addresses the digital divide problem. In addition, Summer Technology Camps, and the High Tech Academy . . . work with local high schools (1,000,000 over five years.)"

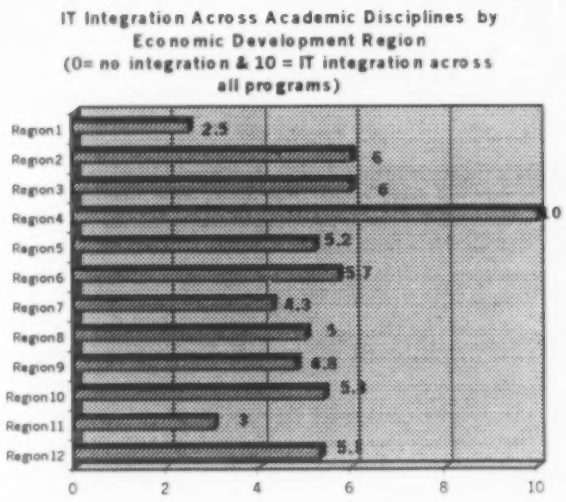
EnterpriseOhio Network: INTEGRATION OF IT LEARNING ACROSS ACADEMIC DISCIPLINES

◆ KEY FINDINGS ◆

Internal Capacity Building:

Using a scale of 0 to 10 (0= not yet found ways to integrate IT learning across disciplines and 10= full integration across academic disciplines), EON campuses combined, rated themselves as 5.3, suggesting room for improvement in this area.

Building on the experiences of EON campuses which have had success integrating and assessing learning achievement in IT across academic disciplines, greater emphasis should be placed on IT integration to strengthen EON capacity overall.



Because market research suggests that as much as one-quarter of all IT workers are graduates of Social Science, Humanities, Other Sciences, and other non-IT disciplines, and Ohio employers are struggling with the technological competency levels of all workers, not just IT specialists, the two year campuses of Ohio were asked about integration of IT learning across all academic disciplines. Specifically, the campuses were asked to quantify their work in this area using a scale of 0 to 10 where 0 represented not yet found ways to integrate IT learning across non-IT disciplines, 5 represented partial integration or about ½ of all non-IT disciplines, and 10 represented full integration of IT learning across all academic disciplines. Where efforts have been made, these campuses were also asked to describe ways in which integration has occurred, including any modifications to curriculum and student learning outcomes.

The overall rating among EON as a whole was 5.3 suggesting room for improvement within this area. There does, however, appear to be varying degrees of integration across EON whereby some campuses report high levels of effort and others minimal to no effort/accomplishment. Analysis of variance for revealed statistically significant differences across economic development regions (sig.=.03). For example, ratings were highest in Region 4 where all 3 institutions surveyed rated their integration of technology at 10. Average ratings were lowest among the 2 institutions representing Region 1 (mean=2.5).

In describing how IT learning has been integrated across academic disciplines, many campuses reported the use of computers and the Internet in specific courses. These included nursing, education, biology, psychology, math, engineering, business, library technology, dental hygiene, radiology, English, writing, physics, occupational therapy, travel, and various 'humanities' and "social science" courses not mentioned by name. One campus reported that "discussions and decisions about integrated IT learning across disciplines is currently underway." Some institutions reported on existing or planned distance learning activities. One described a "variety of on-line courses in non-IT disciplines." Another reported an IT component in "all education curricula."

Several institutions described overall increases in use of Internet research across academic disciplines. The Ohio University Chillicothe campus, for example, offers faculty training in the development of web-based course materials. Other campuses reported increased use of student and faculty email with some indicating that they provide email and Internet access to all students. Both the Miami University at Hamilton and Middletown, for example, described the use of a software product called BLACKBOARD which enables students and instructors to share course material via the Internet.

Some campuses shared details about IT integration in specific courses. A nursing course at Kent State University's Ashtabula Campus, for example, utilizes special software to enhance students' "ability to make medical choices." A math course at Kent State University's Trumbull campus uses computers for tutoring and evaluation. An engineering course at North Central State College combines AutoCAD, welding, and problem solving with other

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engineering concepts. English classes at several institution were reported to have "integrated" word processing "requirements" or "components." At the Ohio Sate University Marion campus an English class a focuses on web page design and a psychology course uses web-based textbooks, course materials, and exams. Edison Community College reported that all English classes are held in computer labs. Several institutions reported the use of the Internet, as well as word processing and graphics presentation software in various business classes. On line student discussion groups are conducted in some Northwest State Community College "humanities" courses. Ohio University's Eastern Campus reported in general terms on the use of "self paced, self-managed learning assignments" in various unnamed courses.

A few institutions discussed their integration of IT across disciplines in more systemic terms. These included cases where the inclusion of IT components in various courses is mandated for faculty. For example, Raymond Walters College reported that 'everyone takes a one credit hour computer awareness class . . . and more than half of other disciplines require IT courses as part of their curriculum." Lima Technical College reported that IT integration has been "facilitated by program review, that "all new programs are required to have an IT component, and that "most program chairs and coordinators recognize the importance of IT." Edison Community College reported that it requires 'every course to have an inquiry component where students use the Internet for research." Although not mandated, Cincinnati State Community and Technical College has created a standard IT course that can be used in "any program." The Ohio University at Zanesville offers a series of one-credit computer courses through its business division that are available for all students.

A more systemic approach to IT integration was also discussed in terms of programmatic or graduation requirements for students. Clark State Community College, for example, reported a computer course requirement for "all degree programs." Shawnee State University reported an "information literacy" course as part of its general education requirement. The University of Cincinnati at Clermont reported that a computer processing introductory course is required for students in "virtually every curriculum."

Some institutions reported requirements in more general terms. Hocking College, for example, stated that it requires "non-IT students to utilize IT training." Similarly, Sinclair Community College referred to integrating and/or requiring "appropriate" IT skill development for all degree programs. Several other campuses simply reported that "all" or "most" degree programs require at least one computer course.

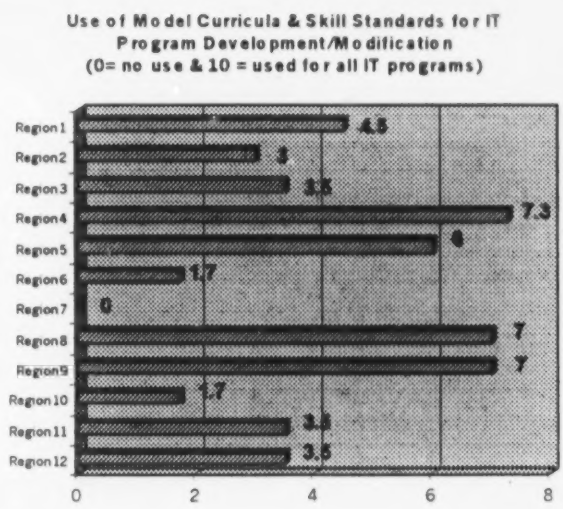
EnterpriseOhio Network: MODEL CURRICULA & SKILL STANDARDS TO INFORM DESIGN/MODIFICATION OF IT PROGRAMS

◆ KEY FINDINGS ◆

Internal Capacity Building:
Using a scale of 0 to 10 (0= no use of model curricula/skill standards and 10 = used for all IT programs), the overall average score for EON was 4.1, suggesting room for improvement.

EON campuses should make greater use of model curricula (like the Ohio Tech Prep/TCP model, learning standards being developed by the Education Development Center, Information Technology Association of America, and National Alliance of Business, as well as the Northwest Center for Emerging Technologies Skill Standards for IT workers) to ensure compatibility of IT instruction and learning with industry needs and demands.

Careful attention should also be given to the incorporation of all three skill sets (soft, business, and technical) described as critical to successful job performance by Ohio employers.



In addition to the integration of IT learning across academic disciplines, the two year campuses were asked to rate their use of model curricula and skill standards, which according to the market research are available to inform the development and modification of IT education/training for greater compatibility with industry needs/demands. Specifically, the campuses were asked to rate on a scale of 0 to 10 the degree to which their institutions have used model curricula skills standards for IT curricula and student learning outcomes. The average rating among all institutions responding was 4.1, again suggesting room for improvement.

In addition, analysis of variance revealed statistically significant differences across economic development regions (sig.=.06) of Ohio, suggesting varying degrees of use across the Network. The rating was highest among the 3 campuses representing Region 4 (mean = 7.3), followed by the 4 campuses representing Region 8 (mean = 7.0) and the 3 representing Region 9 (mean = 7.0). All 3 Region 7 campuses rated their use of model curricula skills standards at 0. The 3 institutions from Region 10 and the 6 institutions from Region 6 also revealed comparatively low average ratings (mean = 1.7 each).

In addition to the self-rating, campuses were asked to provide examples of model curricula skills standards used. Some institutions cited as examples of vendor specific certification programs such as the Microsoft Certified Systems Engineer (MCSE), A+ Certification, Novell Certified Network Engineer (CNE), and CISCO Certified Network Associate Certification. Cuyahoga Community College, for example, reported that "all programs designed in the past three years use industry vendor standards." Owens Community College reported that a "company training program" is used in teaching AutoCAD.

Other examples of industry-specific input for curriculum/standards included those available through professional associations. These included the Association for Computing Machinery's (ACM) Special Interest Group in Computer Science Education (ACM-SIGCSE), and its Networking Curriculum Guidelines (ACM-NCG). The University of Akron's Wayne College cited the use of guidelines prepared by the National Association of Communication Systems Engineers (NACSE) for an Associate Webmaster Certification Exam.

Several institutions reported use of the Tech Prep/itWorks as an example of model curriculum development. Hocking College reported that Tech Prep guidelines are being used to design computer science curricula "linked to the state initiative." Tech Prep was mentioned by Kent State University at East Liverpool in reference to "qualified are junior and senior high school students . . . who spend a half day in our computer tech program." Central Ohio Technical College reported that the Tech Prep model is incorporated into a

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Digital Media Design program. Lorain County Community College reported that it was "exploring its use." Cincinnati State Community and Technical College reported that "all existing and new programs were cross walked against competencies defined by itWorks and modified as necessary to cover defined competencies."

Some campuses cited their existing curriculum review processes as examples of the use of model curricula skills standards. For example, the Kent State University Tuscarawas campus referred to its "Standard University Curriculum Development and Approval Process" and North Central State College to "Established Course Outcomes with minimum competency standards." Edison Community College cited the use of employer feedback from internship placements. Cuyahoga Community College reported that "all programs are built on horizontal and vertical skill ladders and exit points."

Yet other campuses described customized curriculum development processes specific to their institutions. These often included combinations of methods, including Tech Prep/ITWorks, vendor specific certification programs, professional association guidelines, Computer Information Systems faculty input, and input from local employers. For example, the University of Akron reported that "extensive research was conducted . . . (and) all IT programs are critically reviewed by industry practitioners." Cuyahoga Community College reported that European IT standards are reviewed as well as Canadian standards for International benchmarking. The Kent State University Ashtabula Campus reported that:

> "Skill standards are developed by using input from industry leaders. Curriculum is design by university MIS professors with input from professional organizations (e.g., AITP). Curriculum is designed to prepare students for required exams for various professional certifications (e.g., Microsoft, A+)."

EnterpriseOhio Network: INVESTMENTS IN IT FACULTY

◆ KEY FINDINGS ◆

Marketing/Promotion:

EON is making significant investments in IT faculty and instructors to enhance IT learning and achievement for Ohioans with nearly 800 new instructors hired in the last three years alone.

Over a three year period, nearly 800 new IT faculty and instructors have been hired by the 54 two year campuses of Ohio to increase overall IT capacity.

Over 90% of the two-year campuses have also engaged in professional development to improve the technological expertise of all faculty and staff.

Because the national literature reviewed revealed that two and four year IT faculty are among the occupations with current and projected shortfall of workers, the two year campuses were asked to comment on their level of difficulty finding and retaining qualified IT faculty and instructors. In addition, the campuses were asked to identify the number of full-time and part-time faculty/adjunct instructors hired between 1997 and 2000 to better understand the levels of investment the two-year system of higher education is making in IT areas of study.

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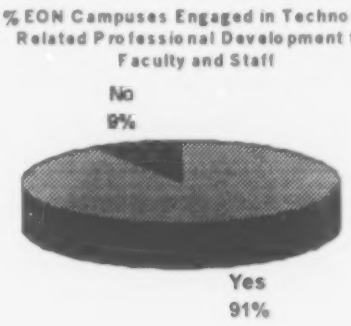
- Over a three year period, nearly 800 new IT faculty and instructors have been hired by the 54 two year campuses of Ohio to increase overall IT capacity.
- Over 90% of the two-year campuses have also engaged in professional development to improve the technological expertise of all faculty and staff.

While nearly 800 new IT faculty/instructors have been hired by Ohio's two year campuses to increase capacity to offer IT education/training, most (86%) have been hired on a part-time basis. A total of 653 new instructors were hired part-time while only 106 of the 759 were hired as full-time faculty.

Using a scale of 0 to 10 where 0 was no difficulty at all retaining IT faculty, 5 represented some difficulty, and 10 extreme difficulty retaining IT faculty, an overall score of 5.7 emerged from the two year campuses. This means that there is some degree of difficulty findings and retaining IT staff. However, some of the retention issues may be due to lack of full-time employment.

In addition to hiring and retention of IT faculty, the campuses were asked whether or not they have engaged in any professional development efforts to improve the technological expertise of all faculty and staff. Over 90% of all campuses reported some kind of professional development activity ranging from opportunities for professional certification to general information about tuition waivers and reimbursement.



Several campuses described opportunities for faculty and staff to seek various types of professional certification. These included CISCO, MCSE, MOUS, N+, I-Generation, AutoDesk, and A+ Certification. Other training mentioned by specific software title or programming language included: MS Windows, MS Word, MS Excel, MS Access, CMDS, Novell, IBM AS400, Blackboard, Photoshop, AutoCAD, Digital Media, HTML, and Visual Basic.

IT professional development activities reported by institutions in generic terms included: web page design, email, pc applications, networking, telecommunications, delivering on-line courses, and software classes. Several institutions reported activities such as 'brown bag' seminars, workshops, on-line courses, summer study, seminars, skills enhancement training, ongoing training, classware workshops, as well as internal, external, and technical training. The Ohio State University's Marion campus cited its "local sharing of expertise."

In terms of specific professional development activities, Lorain County Community College reported that "faculty have taken advantage of credit LCCC offerings (i.e., Multimedia, Adobe Photoshop, HTML Programming, Microcomputer Applications I & II)." Raymond Walters College cited "commercially prepared training funded by the college." A few institutions referred to faculty participation in Tech Prep

seminars. A "University-wide technology conference" is held at Kent State University's Tuscarawas campus every year. At the Hamilton campus of Miami University faculty and staff are invited to attend monthly 'brown-bag sessions to discuss any technology related questions such as computer hardware, software applications, and teaching with technology." This same institutions offers monthly business software workshops featuring "a half hour of information and a half hour of hand-on experience." Lakeland Community College reported "mandatory in-service training." The University of Cincinnati Clermont branch offers the Clermont Technologically Literate College program that includes web page design and Classware workshops for faculty.

Technology related professional development was often reported in terms of institutional support. For example, several campuses cited tuition reimbursement programs, fee waivers, free seminars or workshops, and support for faculty and staff to attend national and local conferences. The University of Cincinnati reported that "grants are offered to faculty for summer study." Southern State Community College reported that its "numerous conferences . . . are very well attended." Muskingham Technical College referred to faculty support for "graduate school." Cincinnati State Community and Technical College reported that IT "professional development activities are encouraged and financed." Cuyahoga Community College reported that "faculty receive $750 per year toward professional development" and may attend non-credit courses at no cost as long as space is available.

EnterpriseOhio Network: TECHNOLOGY ACCESS

◆ KEY FINDINGS ◆

Marketing/Promotion:

The two-year system of higher education in Ohio is equipped with more than 700 computer labs consisting of more than 13,966 workstations.

Near 60,000 students utilize these facilities on a weekly basis.

EON campuses also provide off-site access to computer labs and related equipment for use by Ohio residents.

Internal Capacity Building:
EON should encourage representative campuses to develop more programs offered via distance learning technology to free students from specific time and place as only 13% of all IT degree programs, 8% of IT certificate programs, and only 1% of all non-credit training are offered via technology.

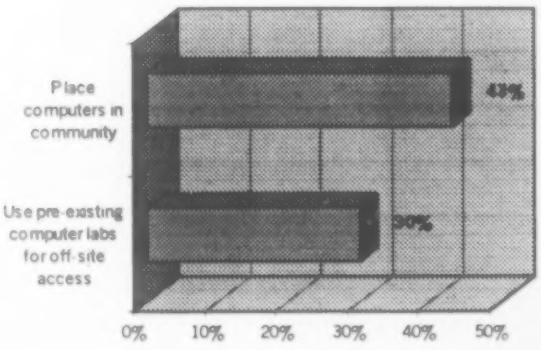
In addition to investments in IT faculty, other resources are necessary for improving the technological capacity of two year students as well as those who would not otherwise have access to related facilities and equipment. As part of the capacity inventory, all campuses were asked to identify the number of computer labs on campus, the total number of workstations in all, and estimated usage of facilities on a weekly basis. In addition, EON respondents were asked if their campus engages in any unique programs to place computers in the community or if they utilize any pre-existing community labs to provide off-site access to local residents.

➡ *EON provides technology access to Ohioans with more than 700 computer lab facilities consisting of nearly 14,000 workstations.*

- The two-year system of higher education in Ohio is equipped with more than 700 computer labs consisting of more than 13,966 workstations.
- Near 60,000 students utilize these facilities on a weekly basis.
- EON campuses also provide off-site access to computer labs and related equipment for use by Ohio residents.

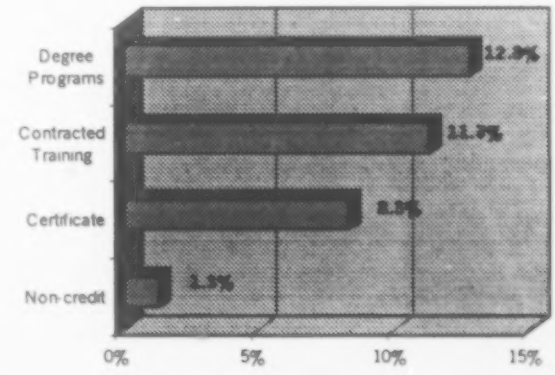
In addition to the702 computer labs, 13,966 workstations and 57,385 students who utilize these facilities on a weekly basis, 43% of all two-year campuses are engaged in programs to place computers in the community. Near one-third of campuses also make use of pre-existing community labs to provide off-site access to local residents.

% EON Campuses Providing Off-Site Access to Computer Facilities



While strides are being made to provide access to Ohio residents, the extent of degree and certificate programs offered via distance learning or other forms of innovative technology is minimal. EON should encourage representative campuses to develop more programs offered via distance learning technology to free students from specific time and place. According to survey results, approximately 13% of all IT degree programs, 8% of IT certificate programs, and only 1% of all non-credit training are offered via technology through EON.

% IT Training Offered Via Distance Learning or Other Forms Technology



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EnterpriseOhio Network: PARTNERSHIPS TO ENHANCE THE SUPPLY OF IT WORKERS

◆ KEY FINDINGS ◆

Marketing/Promotion:

EON campuses are engaged in public partnerships with economic development organizations and welfare to work initiatives to help raise the technological competencies of low income, public assistance, senior citizens, and other populations and attract these individuals into IT careers.

EON campuses partner with private industry in a variety of ways including collaborative work based learning opportunities for students which Ohio employers strongly recommend for adequate preparation of IT workers.

EON campuses connect with K-12 to ensure a consistent and complimentary pipeline of IT education and training.

PUBLIC PARTNERSHIPS:

Partnerships with other public entities are common among EON campuses. Most often the collaborations are with economic development organizations and welfare-to-work initiatives. Low income workers, public assistance clients, senior citizens, and other populations are often the target of these partnerships. EON partner organizations include:

Community Improvement Corporation
East Ohio Gas Roundtable
East Ohio Gas Workforce Development Board
Private Industry Council
Small Business Development Center
Mansfield/Richland Incubator
Economic Development Organization --- Richland County
Digital Initiative Task Force
Workforce Investment Board
Youth Council
Ohio Department of Development
Ohio School Net
Economic Development Corporation
Economic Development Council
Regional Economic Development Consortium
Empowerment Zone

EON PUBLIC PARTNERSHIPS TO ENHANCE SUPPLY OF IT WORKERS

The Kent State University Ashtabula campus uses computer practicums to help local agencies.

The Miami University Hamilton campus hosted the web site for the Butler County Job Fair and the fair itself has become an "integral part of the One-Stop system."

Lorain County Community College is a member of a Digital Initiative Task Force that includes representatives from the area's joint vocational school, the chamber of commerce, and local business and industry.

Columbus State Community College obtained a U.S. Department of Labor grant to provide IT training to displaced workers.

The University of Akron's Wayne College has an Ohio Department of Development Grant for Holmes County to focus on employee retention, including IT training.

Lima Technical College, in partnership with Hardin Economic Development Council and the Putnam County Educational Service Center, operates two off-campus pc training sites in Kenton and Ottawa.

Rio Grande Community College conducts its "Cross Roads" program through the Department of Human Services to provide pc-based office training to area residents receiving public assistance.

Jefferson Community College provides the use of its computer labs to a nearby university to offer computer training to senior citizens.

Central Ohio Technical College partners with its local Department of Human Services Job Prep Resource Center to provide quarterly computer workshops.

Sinclair College works in partnership with the Dayton One Stop to assess IT competencies and provide training to public assistance clients.

Cuyahoga Community College partners with the Cuyahoga County Commissioners to provide computer training to low income incumbent workers .

EON PRIVATE PARTNERSHIPS TO ENHANCE THE SUPPLY OF IT WORKERS

Faculty members at Washington State Community College are engaged with area businesses and organizations in a "Support Tech Practicum."

The Kent State University Trumbull campus secured a "targeted Industries" grants to assist small businesses with their computer training needs.

The Kent State University Trumbull campus is developing on-line training programs for use by companies around the world.

Edison Community College reported that "internships in IT maintain communication between college and industry."

Lorain County Community College is developing a technology park with a primary emphasis on software development. The first company to locate here, a site survey civil engineering firm, has "access to the array of business services the college offers."

The Ohio University Zanesville is currently working with a local Internet service provider to provide wireless Internet access on campus.

Hocking College serves as a data processing center for a Columbus area data processing firm.

Faculty from the University of Cincinnati are working with IBM and Oracle to develop IT courses.

Edison Community Colleges partners with the IT Alliance to offer speakers on IT topics to local industries.

Cincinnati State Community and Technical College serves as a regional training center for Novell Networks.

The Miami University Middletown Campus has agreed to give academic credit to "those of our students who have become IT certified (A+, MCSE, etc.) via training through private organizations or vocational schools."

The University of Cincinnati Clermont campus collaborates with "SDRC to include IDEAS software in our CAD program."

Central Ohio Technical College has engaged in "specific curriculum development for software applications" used by two area banks and a local manufacturer.

Sinclair College has partnered in "jointly developed Fast Track Programmer and Java Enterprise Development Certificates" for several local industries., and also partners with the Miami Valley Research Park Learning Center.

Cuyahoga Community College provides IT-related research to a business magazine to track IT labor trends and local businesses provide employees to serve on "program advisory committees."

PRIVATE PARTNERSHIPS:

The box to the left describes some of the more innovative ways in which EON campuses are partnering with private industry (beyond contracted training services) to enhance the supply of IT workers. Some of the partnerships center around work-based learning opportunities for students, which Ohio employers strongly recommend for quality skill development/acquisition among IT students/learners.

K-12 PARTNERSHIPS:

In some cases K-12 partnerships were described in terms of specific events and activities. For example, the Tuscarawas campus of Kent State University holds an annual "Engineering Exposition . . . with training and competition for high school students in multimedia, graphics design, computer aided design, digital electronics, etc.," as well as an annual "Engineer for a Day program for placing high school students in local businesses." The Ohio State University Mansfield campus conducts a "Computer Camp for Kids (grades 5,6,7,8)." Miami University Hamilton reported that its "Teens in Technology" program features three 10-hour enrichment courses for youth in grades 7 and 8, while its "Kids in College program . . . offer(s) some computer courses for youth in grades 1 through 6." A similar program is offered by Ohio University Lancaster. Both Rio Grand Community College and Hocking College cited a program entitled "Girls in Engineering, Math, and Science (GEMS). Columbus State Community College has "programs to bring under-represented youth to campus." Miami University Hamilton is "currently involved in meetings regarding a new initiative for promoting girls' interest in course and careers in math, science, and technology."

In other cases, K-12 partnerships were identified only by reference to the partner's name. For example, Ohio University Chillicothe partners with the "Great Seal Education Network." Lorain County Community College is a member of the public school Lorain County Distance Learning Consortium. Raymond Walters College is a member of "High Schools That Work." Faculty from Washington State Community College serve on the board of an area vocational school. Sinclair College cited its "Cisco Regional Academy" and its "IT Alliance High School Internship" program. Several institutions cited Tech Prep/IT Works "consortiums," "initiatives," "articulations," "pathways," and "agreements." And, some campuses made reference to School-to-Work partnerships.

Other campuses identified both their partners and the nature of activities. For example, Kent State University Trumbull is working in partnership with the Trumbull County Educational Service Center to establish an "Industrial Technology Career Academy on campus." Lima Technical College offers "telecourses to students in the Putnam County schools." Miami University Middletown has "partnered with local high schools . . . to provide computer technology workshops." It also "hosts an annual Technology Fair which includes a High School Career Day." Faculty from Washington State Community College attend a job fair at a local elementary school. Central Ohio Technical College operates a "JTPA Summer Youth Program." Cuyahoga Community College operates its "Technoventure Certification Camps for teenagers (A+ Certification, Certified Internet Webmaster, and MOUS)" and a "High tech Academy with the Cleveland Public Schools."

EnterpriseOhio Network: KEEPING PACE WITH TECHNOLOGY

◆ KEY FINDINGS ◆

Internal Capacity Building:

IT related barriers reported by EON campuses include:

- Funding
- Physical facility limitations for computer labs
- Finding qualified IT faculty & inability to offer competitive wages/salaries
- High start-up cost of IT certification programs
- Student recruitment/retention in IT programs
- Keeping pace with rapid changes in technology

To enhance internal capacity building efforts, the inventory sought to identify:

- Ways in which campuses keep pace with changing IT marketplace needs and demands to ensure quality service delivery to employer-customers and current/prospective IT workers.
- Current or planned organizational changes or re-structuring to better accommodate IT needs and demands.
- The kind of barriers experienced by campuses in trying to increase the supply of IT workers, in developing IT programs, in re-organization, or other areas.

KEEPING PACE WITH TECHNOLOGY:

EON campuses describe a variety of means for keeping pace with technology which can be broadly categorized in terms of: 1) technology infrastructure; 2) human resource development; and 3) curriculum development. In terms of infrastructure, a few campuses reported either recent improvements or existing processes to continually update hardware and software. The University of Cincinnati at Clermont reported that they "lease equipment to keep current and . . . upgrade software annually." Miami University's Hamilton campus reported that it "focuses on an aggressive . . . upgrade policy for all computers in the computer classrooms and computer labs" and that "new technologies that can aid in teaching and learning are constantly under review." Bowling Green State University Firelands referred to a policy to ensure that no computers are over 5 years old. The Middletown Campus of Miami University cited new "portable laptop labs." Similarly, Ohio University at Zanesville reported that they are "currently renovating the campus and have installed new, state-of-the-art-computer labs."

A variety of methods were reported for ensuring that IT faculty and staff are keeping pace with information technology. Participation in professional development seminars and conferences was cited by several campuses. Lima Technical College referred to the use of "trade magazines and computer software training and retraining seminars," while the University of Cincinnati referred to "self study." Kent State University's East Liverpool campus referred to "regular training and attendance at workshops as required." Several institutions cited membership in various professional associations. Lorain County Community College reported membership in a local software association and regular participation in its "networking and business education opportunities." Professional associations mentioned by name included the Northeast Ohio Software Association, the American Society for Engineering Education, the National Association for Engineering Technologies, the Accreditation Board for Engineering & Technology Curriculum Guidelines, and the Industrial Engineering Technology Advisory Committee.

Curriculum development was discussed in a variety of contexts but often in terms of the role of "advisory committees." For example, the University of Cincinnati's Clermont branch reported that its "technical degree programs have advisory committees that include technical experts working in the field who advise us on program and curriculum updates." Lakeland Community College noted the importance of "quick input from our advisory committees." A few institutions reported the use of "technology committees" to review IT needs for hardware and software upgrades. Southern State Community College reported use of a technology committee in addition to the usual advisory committees structure.

Program development was often mentioned in reference to the institution's involvement of community and industry. For example, Kent Sate University Tuscarawas noted the importance of "maintaining a leadership role in business and industry through groups such as the Chamber of Commerce, the Community Improvement Corporation, and the Knowledge-Based Economic Development Project." Staff from Central Ohio Technical College "meet regularly with human resource managers in business and industry." North Central State College reported that it "reaches out to the corporate community to engage business representatives in dialogue regarding IT needs" and utilizes "on-site visits to ensure understanding . . . of customers' technology and needs." The Mansfield campus of the Ohio State University reported "a new process for assessing needs of businesses through lunches, networking, and various other meetings."

Other efforts mentioned by one or more EON campuses included needs assessments, course evaluations, employer surveys, client surveys, external news feeds, and internship feedback. Jefferson Community College cited "productivity verification of contracted training." Lima Technical College referred to input from "high school advisors." Owens Community College reported that "quarterly evaluations focus on instructional quality, equipment effectiveness, the learning environment, instructional materials and continued support."

ORGANIZATIONAL CHANGE:

The variety of current and planned organizational changes for dealing with IT marketplace demands reported by institutions can be grouped according the following categories: 1) personnel changes and organizational restructuring; 2) existing program restructuring, and 3) new program development.

A few institutions cited organizational change and restructuring in terms of personnel changes. For example, the Ohio University Eastern Campus reported hiring a "workforce development specialist." Miaimi University Middletown reported that a "quarter-time position was created for the purpose of developing computer related curriculum." In some cases additional personnel were incorporated as a part of the creation of a new department or division. For example, Ohio Sate University's Mansfield campus reported on the creation of a "Center for Corporate and Community Education" with a director, program manager and clerical support positions to "meet the needs of business and industry, including IT needs." Similarly, Miami University Hamilton cited the creation of a new department of "Computing Services" that was the result of a 1998 evaluation of existing computing facilities. Yet another institution reported recently hiring both a "Coordinator for Technology Services " and a "Coordinator of Educational Media Technology." This same institution has recently applied for grant funding to establish an adult training site." Edison Community College reported that "we need to split Business from IT and . . . got an IT staff assistant to help."

In some cases, existing IT courses were consolidated into new IT departments. Kent State University Tuscarawas reported that a School of Technology was formed in 1996 to more quickly respond to technology needs." Similar changes are being considered at Jefferson Community College where a proposed "Computer Institute . . . would centralize functions and reduce instructional duplication." Similarly, Lima Technical College reported that "we may separate our computer information science program from the Business Division and make it a 'stand-alone' program." Lorain County Community College reported that its "current thinking is to take a more integrated approach to IT." Southern State Community College reported that its "instructional area is being reorganized with a separate technical division." Similarly, Cincinnati State Community and Technical College reported:

> "The college recently reorganized its entire academic structure, consolidating all computer-related courses into one Information Technologies Division. This consolidation has poised the college to make rapid changes necessary to keep pace with IT and to ensure quality of instruction"

Several institutions described organizational changes ands restructuring in terms of programmatic changes. For example, Rio Grande Community college reported that "IT-related programs in the School of Business were restructured for 1999-2000 and a major and minor were added using updated courses based on previous offerings." Similarly, Owens Community College reported: "most of our IT restructuring deals with expanding the program size or offering custom courses to accommodate our market." Following recent program reviews of its computer engineering and CAD programs one institution reported "degree enhancements with both programs." In more general terms, Clark State Community College reported that "we are emphasizing the need to keep current with technology on campus and to expand our offering of distance and flexible courses to provide improved access to working students and others with schedule limitations." Kent State University Trumbull reported that its "Computer Technology Degree program has been totally reworked to better meet the needs of the IT workforce." Likewise, Sinclair College reported simply that its CIS degree was newly "redesigned to meet current job market demands." The Marion campus of Ohio State University reported that it has "restructured its IT planning and funding allocations."

In some cases, programmatic restructuring accompanied improvements in infrastructure. For example, Washington State Community College has planned a new network lab for the 2000 school year that was "identified as an absolute need by our advisory committee when 3 new network courses were added to our curriculum." Kent State University Geauga reported on a "planned upgrade of computers every 3 years." Kent State University East Liverpool reported on the "renovation and expansion of facilities to increase computer lab and distance learning capabilities."

BARRIERS:

Funding was the most commonly mentioned barrier to increasing the supply of IT workers. Institutions variously referred to "having sufficient resources," "high cost of entry," "up-front, start-up costs," "limited funding sources," and "the expense of keeping current." Funding was often mentioned in reference to equipment, to personnel, or in some cases both. For example, Kent State University Trumbull reported that its "number one barrier is having sufficient resources." Washington State Community College stated that its "number one barrier is the lack of money; money for staff, and money for equipment-hardware and software."

Comments relating to hardware costs included: "funds for state-of-the-art equipment," "the expense of keeping current with upgrades," and simply "equipment costs." North Central State College reported that it "could provide more and better training if additional dollars were available for IT-related software and hardware acquisitions, i.e., Viewgraphics, Interactive Media Technology, and other more powerful IT offerings." Cuyahoga Community College also referred to the "expense of buying new and upgrading existing hardware and software."

In some cases, barriers relating to facilities and equipment was discussed without reference to cost or funding. These included references to "room scheduling/lab space," "physical limitations," "classroom expansion," "lab upkeep and installation," "lab space limitations," "lack of sufficient computer labs," "lack of equipment," and "lack of server space." Similarly, Muskingham Technical College reported on a "lack of sufficient computer labs."

Comments related to personnel costs included Owens Community College's reference to "competition with industry for qualified instructors." Similarly, the University of Cincinnati reported that "universities usually can't offer IT candidates the salary they could make in the private sector." Similarly, Owens Community College

described the barrier in terms of "being able to offer competitive wages with that of industry for qualified instructors."

Cost and salary issues aside, several campuses described barriers in terms of simply locating qualified instructors. For example, institutions variously reported on a "lack of instructors," the difficulty of finding "faculty to teach certification areas." "finding/hiring qualified IT instructors," "recruiting and retaining qualified IT faculty." "Finding enough qualified part-time faculty to meet the demand" was considered a barrier by Sinclair College. Rio Grande Community College stated that "faculty positions in Computer Science have been hard to fill with qualified IT instructors with the range and depth of competencies needed." Northwest State Community College stated simply that "instructors cannot be found." Muskingham Technical College reported a "lack of sufficient NCA credentialed faculty."

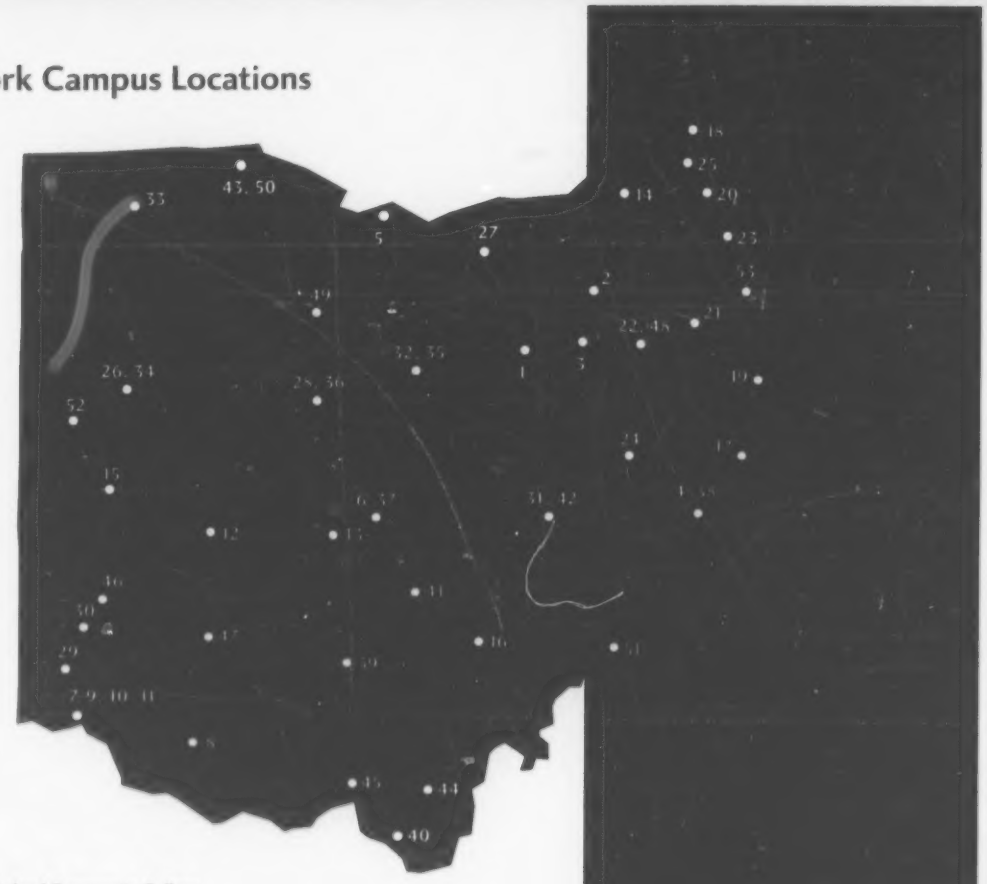
Barriers were also discussed in reference to the difficulties of program development, often in the context of cost. For example, Edison Community College cited "money for start-up" as a barrier. Kent State University's Stark campus referred to "high start-up costs for certificate programs and rapid changes in certification." Miami University Middletown cited the "frequent changing of IT certification criteria" as a barrier. Cuyahoga Community College reported on the "continuous tuning of curriculum to keep up with rapid changes." Lorain County Community College referred to "being able to forecast upgrades so that training needs evolve as software emerges and changes" and expressed concern in terms of "knowing if there is the target market to deliver the training."

Attracting students to IT programs was also described as a barrier by some. For example, Kent State University Ashtabula reported that "the pool of potential students is limited." Kent State University Geauga noted that "non-traditional (students) are often afraid of computers. The University of Akron Wayne College reported that "much of the high-end IT training is difficult and this causes retention issues." "Lack of fundamental math skills was reported by Jefferson Community College while Shawnee State University reported that "finding prospective students who have good mathematical and analytical skills" is a barrier. Similarly, Rio Grande Community College reported:

> "Few students are able to meet the math requirements and demands for the Computer Science Industrial Automation, or Computer repair programs." While there are reasonable numbers of students entering these programs, comparatively few are able to graduate in these programs. There is a need for reaching students early (9th and 10th grades) to tell them about IT careers and what is needed to prepare for those careers, beginning with their high school math courses."

The University of Cincinnati Clermont, Lakeland Community College, and Jefferson Community College all described barriers related to students leaving IT programs to take computing jobs before completing their degrees. Columbus State Community College cited "competition from the private sector" as a barrier. Citing its success in permanently placing graduates with firms following successful internships, Rio Grande Community College cited as a barrier the fact that there are "relatively few IT companies in the area," and that "more internship opportunities is a major need." Southern State Community College, on the other hand, reported: "we have not experienced any real barriers that have seriously reduced initial enrollments."

EnterpriseOhio Network Campus Locations



1 **Agricultural Technical Institute - Ohio State University**
Wooster

2 **University of Akron Comm. & Tech. College**
Akron

3 **University of Akron - Wayne College**
Orrville

4 **Belmont Technical College**
St. Clairsville

5 **Bowling Green State University - Firelands**
Huron

6 **Central Ohio Technical College - Newark**
Newark

7 **Cincinnati State Technical and Community College**
Cincinnati

8 **University of Cincinnati - Clermont**
Batavia

9 **University of Cincinnati - OMI/AS**
Cincinnati

10 **University of Cincinnati - Raymond Walters**
Cincinnati

11 **University of Cincinnati - University College**
Cincinnati

12 **Clark State Community College**
Springfield

13 **Columbus State Community College**
Columbus

14 **Cuyahoga Community College**
Cleveland

15 **Edison State Community College**
Piqua

16 **Hocking College**
Nelsonville
ext.2805

17 **Jefferson Community College**
Steubenville

18 **Kent State University - Ashtabula**
Ashtabula

19 **Kent State University - East Liverpool**
East Liverpool

20 **Kent State University - Geauga**
Burton

21 **Kent State University - Salem**
Salem

22 **Kent State University - Stark**
Canton

23 **Kent State University - Trumbull**
Warren

24 **Kent State University - Tuscarawas**
New Philadelphia

25 **Lakeland Community College**
Kirtland

26 **Lima Technical College**
Lima

27 **Lorain County Community College**
Elyria

28 **Marion Technical College**
Marion

29 **Miami University - Hamilton**
Hamilton

30 **Miami University - Middletown**
Middletown

31 **Muskingum Tech**
Zanesville

32 **North Central State College**
Mansfield

33 **Northwest State Community College**
Archbold

34 **The Ohio State University - Lima**

35 **The Ohio State University - Mansfield**
Mansfield

36 **The Ohio State University - Marion**
Marion

37 **The Ohio State University - Newark**
Newark

38 **Ohio University - Eastern Campus**
St. Clairsville

39 **Ohio University - Chillicothe**

40 **Ohio University - Southern**
Ironton

41 **Ohio University - Lancaster**
Lancaster

42 **Ohio University - Zanesville**
Zanesville

43 **Owens Community College**
Toledo
Findlay

44 **Rio Grande Community College**
Rio Grande

45 **Shawnee State University**
Portsmouth

46 **Sinclair Community College**
Dayton

47 **Southern State Community College**
Washington Court House

48 **Stark State College of Technology**
Canton

49 **Terra Community College**
Fremont

50 **University of Toledo Community & Technical College**
Toledo

51 **Washington State Community College**
Marietta

52 **Wright State University - Lake Campus**
Celina

53 **Youngstown State University**
Youngstown

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